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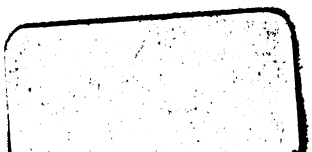

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WALKS IN THE REGIONS OF SCIENCE AND FAITH

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WALKS IN THE REGIONS OF SCIENCE AND FAITH

A SERIES OF ESSAYS

By HARVEY GOODWIN, D.D.

LORD BISHOP OF CARLISLE

HONORARY FELLOW OF GONVILLE AND CAIUS COLLEGE, CAMBRIDGE

Ἐν αὐτῷ κατοικεῖ πᾶν τὸ πλήρωμα τῆς θεότητος σωματικῶς, καὶ ἐστε ἐν αὐτῷ πεπληρωμένοι

WITHDRAWN

LONDON

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1883

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PREFACE.

A VOLUME which opens with an essay on the connection between mechanics and geometry, and which closes with a funeral sermon preached in Westminster Abbey, may perhaps be justly accused of containing materials of a somewhat miscellaneous character. Nevertheless, there is a strong thread of connection running through the following pages; and I have endeavoured to express this connection by the title, 'Walks in the Regions of Science and Faith.' At all events, this title sufficiently describes the kind of country through which I shall lead any reader who may be disposed to accompany me in my rambles. The reader will conclude from the title that he will find in the book discussions of matters scientific and religious, and he will not be disappointed; at the same time the volume is not a scientific treatise, nor yet what is called a religious

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book; it deals chiefly with questions which have both a scientific and a religious aspect, or, according to its figurative title, it contains the record of wanderings through that land which belongs exclusively neither to science nor to faith, but appertains more or less to both. There are matters lying within the region of faith which may be advantageously discussed with the highlands of science in view, or the discussion of which may be helped by climbing a few steps up the hills with which Science-land abounds.

To drop all metaphor, the progress of human knowledge during the present century compels every one who thinks at all to think with his eyes open to the results of physical science. Morals and religion have, of course, still their own territory, and their territory should be carefully and courageously guarded against invasion. But the moral and religious views of men will generally be modified by the necessity of recognising indubitable physical truths; and even if this be not so, still the protection of the territory of which I spoke just now, if it is to be wise, righteous and successful, must take account of the nature of the attacks made upon it, and must not expend itself in charging windmills, nor court defeat by the use of antiquated or worn-out weapons.

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Every preacher of the Word of God must feel that one use to which the pulpit should be applied in these days, in an educated country such as our own, is the diffusion of sound thought on the subject of the relation in which human and divine knowledge stand to each other. It is difficult to do this well, because it is difficult for one man to obtain a sufficient mastery of the two branches of knowledge to be able to judge fairly of the claims of both: consequently, clergymen not unfrequently talk rashly concerning human science; perhaps scientific writers sometimes talk rashly concerning things divine. But even if a clergyman be well acquainted with the two great branches of knowledge, there is much to be said concerning their relations to each other which can find no place in pulpit teaching: a bishop or a priest may have thoughts on this and kindred subjects, which he believes it would be profitable to make known, and which yet can find no convenient place in a sermon delivered to a mixed congregation. I have no right to claim high position with respect to either science or theology; but the acquaintance which, as a Cambridge man, I possess with those branches of science which are susceptible of mathematical treatment, frequently leads me to view questions of con-

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troversy in a way different from that which might otherwise present itself, and at least impresses upon me very forcibly the necessity of not forgetting science while discussing theological questions.

It is with this feeling that I have of late years published several essays in periodicals; and I take this opportunity of thanking the Editors of the 'Nineteenth Century' and the 'Contemporary Review,' for their courtesy in permitting me to reproduce in this volume papers which have already appeared in their pages. I have with the same feeling delivered lectures on several occasions upon semi-scientific, semi-religious subjects, some of which I have here reproduced. Two essays have not been in print before, and another is re-written from a newspaper report of an address delivered to a local society. The volume closes with a funeral sermon preached in Westminster Abbey on the Sunday after Mr. Darwin's funeral.

The text of this sermon may be regarded as indicating the relation in which human knowledge stands to divine, and as containing a principle upon which (as I believe) students of all kinds of science may be urged, without injustice or indignity to any kind of knowledge, to take their stand in brotherly union. 'Complete in Him.' Complete in Christ. The results

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of scientific investigation and observation of nature, and the pushing of hypotheses to their legitimate conclusions by all means which the reasoning powers of man supply, will find their complement, not their contradiction, in the knowledge conveyed by the mission of Him who is both God and man. A grand conception this; one at which the head has no right to sneer, and which the heart receives with joy and with an instinctive persuasion that it must be true.

HARVEY CARLISLE.

ROSE CASTLE: *Easter* 1883.

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ESSAYS.

ESSAY I.

THE CONNECTION BETWEEN MECHANICS AND GEOMETRY.[1]

THE first step in proving the elementary propositions of mechanics is usually to explain that, for the purposes of demonstration, forces are represented by straight lines; and so simple a step does this appear to be, that it has been complained that students frequently do not perceive that they have passed a distinct boundary-line in their transition from geometry to mechanics. It becomes, therefore, an interesting inquiry, What is the ground of connection between the two sciences? Is it merely conventional, or only partly so, or not at all? Is the substitution of straight lines for forces to be looked upon as an ingenious device, or has it such a natural basis in the reality of

[1] This Essay is a modified reprint of a memoir read before the Cambridge Philosophical Society in the year 1845, and published in the Society's 'Transactions.'

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things as to force itself in one form or another on the mind of every one capable of appreciating the subject? This is the question which I propose to examine.

Let it be observed, then, that an indefinite straight line is merely the expression of the idea of *direction*. The idea of direction may, I think, be described as a pure idea, capable of no simpler expression, and not derived from experience. No child ever walked by a roundabout path from one point to another until it discovered that one path was shortest. There may be a difficulty in understanding what precisely is meant by a straight line lying *evenly* between its extreme points; but about the fact that you would go in one determinate *direction* from one point if you wished to go to the other, there would be no doubt at all. I hold, therefore, that the idea of direction is what may be described as a *pure* idea, independent of experience, and that all definitions of a straight line are attempts, accompanied with more or less success, to give verbal expression to this idea.

And so when I draw a mark upon paper which I call a straight line, this is a method of representing rudely to the eye a certain *direction*: it enables me to speak intelligibly of that direction, and to reason about it, the reasoning of course referring not to the mark on the paper, but to the ideal straight line or direction of which that mark is the visible memorandum.

When we speak of a *finite* straight line we limit

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the idea of mere *direction* by introducing the new idea of *magnitude.* The idea of magnitude depends simply upon the comparison of one quantity with another; and a straight line of a certain magnitude is represented by taking two points on a given indefinite straight line, such that the distance between them shall be so many times greater than the distance between two standard points.

Thus a finite straight line given in position is the expression of the combined pure ideas of *direction* and *magnitude*: and a mark upon paper standing for such a straight line is the exhibition to the eye of these two combined ideas.

Hence, further, we may say that all propositions concerning indefinite straight lines are deductions from the pure idea of direction; all propositions concerning finite straight lines, not given in position, are deductions from the pure idea of magnitude; and all those concerning finite straight lines, given in position, are deductions from these two pure ideas combined. In short, a finite straight line has no other elements than those of magnitude and direction: everything which can be predicated of a finite straight line must be predicated in virtue of these two elements.

From this point we can see a simple road into mechanical science. If there be anything physical which depends upon no other elements than those of magnitude and direction, there is no reason why a mark upon a piece of paper should not stand for this

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physical embodiment of the two ideas as well as for the geometrical: and further, if there be anything physical of which it can be predicated that it has no other elements than magnitude and direction, then all propositions which have been proved for finite straight lines will have their corresponding propositions; in fact will be true, with a change of phraseology, in physics.

In devising, therefore, a method for representing to the eye the forces on which we reason in mechanics, the question is not whether a force can be conveniently represented by an ideal straight line, but whether a force has such qualities that the representation which serves for demonstrations respecting straight lines will also serve for the demonstrations respecting forces.

Now, when we examine a mechanical force we find that it does involve, or rather it is a physical expression of, those two ideas of *direction* and *magnitude*, and of no others. For we measure a force by the pressure which will counteract it: and what are the questions as to the counteracting pressure? These two: in what direction it must be applied, and with what intensity. It is clear that neither of these is sufficient without the other: a particle left to itself under the action of a force will move off in a certain determinate direction; and it is a truth which requires no proof, but is purely axiomatic, that a force, however great, applied in any other direction than the exactly

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reverse of this, will not prevent motion. So likewise it is a self-evident fact that the counteracting pressure must be of a certain determinate magnitude, and of no other. Thus, to a person who understands what is meant by the term *force* it will be apparent that the only ideas involved are those of *direction* and *magnitude*: any cause tending to produce motion which involves any other element for its complete determination is not a *force*: it may be so called popularly and loosely, but it is not included in the mathematical definition.

And it may be observed that, as in Euclid, the definition given of a straight line—namely, that 'it lies evenly between its extreme points'—is virtually superseded by the axiom that 'two straight lines cannot enclose a space;' so in elementary treatises on mechanics, although the definition given of a force is that it is 'any cause which produces or tends to produce motion,' yet the fundamental proposition is usually made to depend upon the axiom or fact (or whatever it is to be called) that a force may be supposed to act at any point in its direction; which is the same thing as saying, that if the magnitude be given, the force depends upon direction only.

Let it be granted, then, that the only ideas involved in that of force are those of direction and magnitude. We thus come to the case (already spoken of by anticipation) of a thing physical involving exactly the same ideas as the finite straight line in geometry;

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and we may therefore lay down this proposition, that every theorem regarding straight lines in geometry will have its fellow in mechanics, that the theorems of one science can be translated into the language of the other, and the demonstrations belonging to figures in which the marks represent straight lines will apply precisely as well to similar figures in which the marks represent forces : in both cases the representation must be conventional : no ink-mark can be a straight line, and no proposition concerning straight lines can be true of the ink-marks which represent them ; and though it requires a greater abstraction of mind to speak of an ink-mark as a force than to speak of it as a straight line, yet to speak of it in this latter character is certainly as really though not so palpably conventional, and the proper office of figures in both cases is to assist the mind in drawing deductions from the pure ideas of direction and magnitude.

Velocity is another instance of a thing physical involving the ideas of direction and magnitude only ; and of it, therefore, it may be predicated that propositions respecting a straight line are true also of it, *mutatis mutandis*.

When it is said that every proposition respecting the straight line will have its fellow respecting force, it is of course equally true that each proposition in mechanics will have its fellow in geometry. Consequently it may be asked, What proposition in geometry corresponds to the parallelogram, or rather the

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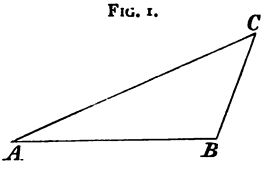
triangle of forces? To which I reply, that when two straight lines A B, B C are given in position and magnitude, the straight line joining the points A and C will be as strictly their geometrical resultant as the force represented by A C will be the resultant of the forces represented by A B, B C. For by speaking of the resultant of two straight lines we necessarily imply that the two lines are given to determine some third object; and that object must be a straight line, since the resultant of two things of the same kind must obviously be of the same kind with those which produce it; and if there be any line which is to be considered as the resultant of A B, B C, it must be A C, since this is the only new line whose position and magnitude are in any way whatever determined by the positions and magnitudes of A B and B C. If, therefore, we mean by the resultant of two straight lines given in position the straight line which is determined in magnitude and position by these straight lines—and this seems to be the obvious or only meaning to be assigned to the term resultant—then A C is the *resultant* of A B, B C.

Fig. 1.



The problem of finding the resultant of two straight lines given in position may be generalised into that of finding the resultant of any number of straight lines forming an imperfect polygon. For if all the sides of a polygon be given except one, then

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that one will be the resultant of all the rest; it is the only new straight line whose position and magnitude become determinate in virtue of the other sides being given. It may be said that the extremity of one of the last sides may be joined with one of the angular points, and that thus some other line will be determined: but the obvious answer is, that this will not employ *all* the data, and that the line so determined will be the resultant of all those which have been really used. In fact, a straight line may be given just as really, though not so directly, by giving in position all the other sides of a polygon of which this straight line forms the last: to give these other sides is precisely the same thing as to give the line itself.

Conversely, a straight line may be considered as the resultant of any system of straight lines which with it will form a polygon; and also in such polygon any one side may be called the resultant of all the rest. If two be missing, they cannot be replaced; if one only, then is that missing one just as fixed and determinate as if it were represented by an ink-mark as part of the polygon.

The principle of the third side of a triangle being the resultant of the other two may be applied to the demonstration of certain propositions in plane geometry, which I here introduce for illustration's sake.

It may be shown from this principle that the straight lines drawn from the bisections of the sides of a triangle perpendicular to the sides will pass

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through the same point. For suppose we bisect two of the sides, and draw straight lines perpendicular to them (it is of course necessary to *bisect* the sides, because the middle point of a line is the only one which is similarly related to the two extremities), then these indefinite lines determine a new point, namely, the point of intersection. Now, if we perform the same operation on the third side, the result must be such that no new geometrical element is determined, since everything determinable by the third side is already implicitly involved in the knowledge of the other two. Therefore this third line must pass through the intersection of the other two, since if it did not it would determine two new points, which, by what has just been said, is impossible.

The same reasoning applies to the theorems, that the lines bisecting the angles of a triangle pass through the same point, and that the lines joining the angular points with the bisections of the sides pass through the same point.

And I may remark that we have probably here the explanation of the fact, that propositions in pure geometry sometimes admit of simpler proof by reference to mechanical considerations than by the ordinary geometrical methods; for example, the last proposition of those just cited finds its solution at once in the property of the centre of gravity of a plane triangle.

Taking the view which I have thus endeavoured

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to expound of the resultants of straight lines, it will be obvious how close is the analogy between this case and that of forces. For if A B, B C (see diagram, p. 7) represent two forces, then A C, as we know, represents their resultant; and in general, if two sides of a triangle represent two forces, their resultant is given by the third; and still more generally, if the sides of an imperfect polygon represent forces, their resultant is given by the last side. Now the same thing holds true in this case which was true in the case of geometry—namely, that if A B, B C be given in position and magnitude, the only third thing determined is A C; and therefore, if A B, A C represent two forces, the magnitude and direction of the force A C is at once determined, but this can be asserted of no other force. Now I do not say that this could be accepted as a full and proper proof of the triangle of forces; but I do think that it is a mode of considering the subject which, by careful thought, may lead to the intuitive perception of the truth of the proposition. It might be impossible to admit this as the only proof that the force A C would *balance* the two A B, B C; but at least it shows that A C is related to A B and B C in a manner in which no other force is related, and that it is determined by them, so that to give *them* is to give *it*, and that this can be predicated in the same sense of no other force; and from this it seems possible to arrive at an intuitive perception of the truth that A C is in reality the resultant of A B and B C. And this is

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the point at which we should endeavour to arrive; the fundamental proposition in mechanics ought not to have a merely artificial basis, ought not to be so proved that the mind rather *concedes* its truth because it cannot deny it, than *sees* it to be true; and I cannot feel a doubt but that there must be some method of viewing the subject, by adopting which the fundamental propositions of mechanics will gradually grow into as perfect axiomatic clearness as do the simple propositions of geometry.

To illustrate this point by contrast, let us consider for a moment the proof which is frequently given, or used to be given, in elementary treatises, of the triangle or parallelogram of forces; I mean that which is due to and goes by the name of Duchayla.

Now, this proof is certainly convincing; that is to say, it is not possible to point out any flaw in the steps of demonstration; but for *persuading* the intellect it appears to have no fitness. The proof is essentially artificial, and is based on a simple case of composition of forces, which seems very insufficient to suggest, as it is pretended that it does, the result sought. The character of the proof seems, if I may so express myself, to be that of *cunning* rather than that of open-faced argument; and yet I think that, however unsatisfactory the proof may appear when viewed in this light, we feel convinced that there must be a meaning and a principle in it, and that these are only smothered and obscured by the artificial contriv-

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ances of the demonstration. This perhaps we shall perceive really to be the case, if we examine the demonstration in the light of the observations already made in this essay. The first part of the proof seems to involve very faintly the idea of force; the only principle introduced being this, that a force may be supposed to be applied at any point in its direction; and thus the distinctness of the proposition as a *mechanical* one seems to be rather obscured. But this difficulty vanishes if this first part of the demonstration be regarded as what I should call a proposition in the science of *pure direction*; the proof involves the idea of force faintly, because indirectly, and because the proposition is truly of several things, of which force is only one; it is equally true of *velocity*, for example: force is only one embodiment of the idea of pure direction, and therefore all theorems of pure direction will belong to force, not singly, but in common with all other embodiments of the same idea. In fact, the first portion of Duchayla's proof appears to be equivalent to this: given two straight lines in position, to ascertain the direction which will be determined by them.

But direction is not the only idea involved in force. There is magnitude as well. Therefore there is a second portion of the proof we are considering, in which it is shown that, allowing the triangle of forces as far as direction is concerned, that part which regards magnitude necessarily follows. The extreme

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simplicity of this part of the proof shows how intimate the connection must be between the two parts of the proposition, a connection for which we perhaps should not have been prepared by anything occurring in the proof itself. For although the fact that the direction of the resultant of two equal forces will bisect the angle between them is taken as suggestive of the general law of direction, there is not a shadow of a hint that in this simple case the law will hold as respects magnitude. So that a remarkable proposition is proved by a mere artifice, without apparently the least reason in the nature of things why we should anticipate the result. But if we consider the proposition from the same point of view as that from which we have regarded the question of the resultant of two straight lines, we shall see that there is a necessary connection between the two propositions—I mean those respecting *direction* and *magnitude*; for when we had two lines A B, B C given, the resultant A C became known both in *direction* and in *magnitude*; the two things were co-ordinate; in fact, as this word suggests, they were merely two new *co-ordinates* of C which became known from the two given co-ordinates A B and B C.

On the whole, I would urge that the proposition which we call the triangle of forces is a result of the combination of the pure ideas of *direction* and *magnitude*, and will therefore be true in some sense of all concrete existences which are embodiments of these

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two ideas and none other. Therefore I explain the fact of the unmechanical character of the proof we have been considering by observing that the proposition is more general than the mechanical one; includes, in fact, the triangle of forces, the triangle of lines, the triangle of velocities, the triangle of couples, and perhaps some other cognate propositions.

The preceding remarks have been wholly devoted to the consideration of force as acting on a single particle. It might have been possible, perhaps, to discuss the case of a system of forces acting upon a rigid body, and to have shown how the science of mechanics diverges from that of geometry by the introduction of this new idea of rigidity. But what has been already said will be quite sufficient to put in a clear light the fundamental views which it has been my desire to explain: my belief is, that these views contain the shadow at least of important truth, and that they will be seen to do so by any one who will devote attention to the subject. The great question is, What are the fundamental ideas of elementary mechanics, and what of geometry? Are they the same, or are they cognate, or are they altogether distinct? If the last, then the resemblance between certain propositions in the two sciences is a curious and unexplained fact; but if the second or the first, then the explanation is obvious.

And if the relation of the two sciences be such as I have represented it, then it seems important that it

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should be recognised, and that for more reasons than one. In the first place, this view connects two streams of truth, usually, I believe, considered distinct, and traces them to one fountain-head; and this is an important simplification, in the same sense and for the same reason that it is an important simplification to trace two phenomena to the same physical cause. But again, the foundation of geometrical truth is a matter of less question in general than that of mechanical; it is, I suppose, universally allowed that the propositions of pure geometry are as they are, because they could not be otherwise—that they are necessary truths in every sense in which truths can be necessary; but there is not, I apprehend, such clearness of thought prevalent respecting mechanical truth: it is difficult to make out from the ordinary books on the subject what the writer's belief is respecting the nature of the truths which he is developing. Now this point is entirely resolved, if it is shown that the principles of mechanics are identical with those of geometry, that the two sciences not only have certain analogies, but are in essence identical, as being developments in different subject-matters of the self-same ideas; and hence, if this be true, we see the necessary character of the propositions of mechanics, or at least we show them to stand on the same ground as others which are supposed to be admitted to be necessary.

I will close this paper by saying that, although I

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acknowledge that what has been adduced in favour of the views propounded may not with many appear to amount to demonstration—and indeed demonstration in such a subject is, perhaps, not altogether possible—yet I am persuaded of their fundamental correctness by this consideration as much as by any, namely, that they seem to point out the road to the absolute intuition of truth; they seem to mark out a method of thought according to which the elementary truths of mechanics will present themselves gradually with axiomatic clearness. And certainly, whether this method be true or not, it cannot, I think, be doubted by any one who has reflected on the foundations of truth, that this is the natural course, that all demonstrations tend to merge in intuition, and that human knowledge, as it becomes more clear and is more thoroughly apprehended, converges towards that absolute intuition which is the attribute of the Divine mind.

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ESSAY II.

THE UNITY OF NATURE: A SPECULATION.[1]

WHATEVER view we take of Nature—by which name I intend to express the material system of which we ourselves form a part—there can be no doubt as to a certain unity pervading it. I will not say a unity of purpose or design, because it is sometimes said that there is no purpose and no design in nature; but those who would be most ready to deny purpose and design would be most earnest in asserting the existence of unity of a very distinct kind.

Of course, those who adopt the old belief, held by Jews, Christians, and Mohammedans, in the existence of One God, Maker of Heaven and Earth, virtually assume the existence of a unity pervading creation. The oneness of the creating mind implies a corresponding oneness in the created work. All phenomena, whether moral or physical, which seem to imply diversity of will or purpose, are set down to the

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account of unexplained anomalies; they are the almost necessary results of a partial understanding of a complicated system; they are candidly admitted as existing; they are left for possible future explanation; but, whether explained or not, they are not permitted to interfere with the great fundamental axiom of the unity of God and the corresponding unity of creation.

This theological aspect of the subject, the name of which I have placed at the head of this essay, I mention as in duty bound, but do not intend to discuss. The aspect upon which I wish to offer a speculation is entirely scientific and experimental, and in no direct manner touches upon the domain of theology. Let me illustrate it by reference to the remarkable discourse upon Biology delivered by the President of the British Association at the meeting in Sheffield, held in 1879.

The ground-tone of that discourse, if I rightly understand it, is the unity of the principle of physical life, whatever that principle may be. Dr. Allman traces life up from the simplest form of protoplasm to its highest exhibition in the bodily systems of mammals and men.

> No one, he says, who contemplates this spontaneously moving matter can deny that it is alive. Liquid as it is, it is a living liquid; organless and structureless as it is, it manifests the essential phenomena of life.

Then he takes us to the simplest living organism, the *Amœba*.

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The science of our own days has revealed its biological importance, and shows that in this little, soft, nucleated particle we have a body whose significance for the morphology and physiology of living beings cannot be overestimated; for in the *Amœba* we have the essential characters of a cell, the morphological unit of organisation, the physiological source of specialised function.

From the *Amœba* we ascend to man himself.

Examine under the microscope a drop of blood freshly taken from the human subject, or from any of the higher animals. It is seen to be composed of a multitude of red corpuscles, swimming in a nearly colourless liquid; and along with these, but in much smaller numbers, somewhat larger colourless corpuscles. The red corpuscles are modified cells, while the colourless corpuscles are cells still retaining their typical form and properties. These last are little masses of protoplasm, each enveloping a central nucleus. Watch them. They will be seen to change their shape; they will project and withdraw pseudopodia, and creep about like an *Amœba*.

But the protoplasmatic chain which connects all animal life links it on also to that of the vegetable world.

All recent research has been bringing out in a more and more decisive manner the fact that there is no dualism in life—that the life of the animal and the life of the plant are, like their protoplasm, in all essential points identical.

And this truth Dr. Allman illustrates by a most curious fact, the evidence for which seems irresistible, namely, that plants, like animals, are capable of being acted upon by anæsthetics: the sensitive plant under

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the influence of the vapour of ether loses its sensitive properties; and seeds under a similar influence are unable to germinate, but recover their vital power as soon as the anæsthetic atmosphere is removed.

This unity of the principle of physical life may or may not astonish us according to our habits of thought: possibly we may begin by regarding it as astounding, and end with the conclusion that it would be difficult to have conceived it to be otherwise. This is a mental transition with which most persons accustomed to scientific, and especially mathematical scientific, discussions will be familiar. The real difficulty of conception seems to me to be connected with the diversity of nature, supposed to rest upon one all-pervading principle. Grant protoplasm as the prime form of universal physical life; take that as the biological starting-point or prime postulate; and then comes the difficulty of conceiving the immensely different results in which our protoplasmatic postulate lands us. The most absolute upholder of protoplasm, assisted by the hypothesis of evolution, must of necessity conclude that there is somehow an enormous difference between a squirrel and a codfish, between a dog and a cabbage.

I apprehend that this combination of a deep underlying unity in nature with a palpable and unlimited diversity will always afford opportunity for curious speculation, and will probably never admit of a complete solution. Mr. Darwin's hypotheses and

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investigations, regarded from one point of view, may be described as an attempt to solve the difficulty. To what extent the attempt has been successful I have no intention of discussing: the purpose of this essay is of a very different kind: I am content to look upon the unity and diversity of nature either from the simple theological point of view, or from that of science, as expounded by Mr. Darwin or any other leader whether in science or in philosophy; and, accepting the admission which must be made by all parties of the coexistence of fundamental unity with almost unlimited diversity, I wish to offer some considerations which may possibly be helpful to some minds in their attempts to grasp this coexistence as a thing approximately intelligible. Considerations which interest one mind may probably interest others: at all events I shall have the selfish pleasure of setting down in words a speculation, interesting as I think, which has occupied my own thoughts.

The scope of my speculation will perhaps be put before the reader in the clearest manner by propounding the following question:—

Is it not conceivable that there may be a principle or law, from which the existing order of physical life, with all its apparent anomalies, flows as a necessary result? and would not the knowledge of that principle or law, if attainable, exhibit to us the order of living nature, as one consistent system, free from exceptions and anomalies?

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Let us consider what takes place with regard to geometrical knowledge. We are told that Sir Isaac Newton regarded the propositions of Euclid as necessary truths requiring no demonstration, and that he did not trouble himself to follow the steps of proof. This is not a common experience, as most students have discovered for themselves; but it is quite true that every mind that is capable of geometrical knowledge approximates by degrees to the condition from which that of Sir Isaac Newton seems to have started. The boy who begins his geometrical studies works painfully through the logical steps by which it is proved that the three angles of a triangle make up two right angles; that the squares described upon the two sides of a right-angled triangle make up that described upon the hypothenuse; that the tangent of a circle is perpendicular to the radius; and so forth; but, by degrees, as his mind becomes familiar with the fundamental conceptions of straight lines, angles, circles, and the rest, he begins to perceive that propositions which at first sight seemed almost as wonderful to him as protoplasm or an *Amœba* to the microscopist, are in reality self-evident, or immediately deducible from the simplest axioms. And, what is still more to the point, a geometer who has thoroughly digested his science is capable of regarding the whole body of propositions into which it is divided as scientifically one, and as all obviously, and (so to speak) visibly, depending upon the simplest and most ele-

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mentary properties of space. The extent to which this intuition of geometrical truth can be carried depends upon the powers of the human mind. The propositions of Euclid appeared intuitively true to Sir Isaac Newton, and I suspect that this does not give us the intuitive limit of his geometrical powers; anyhow, it is quite conceivable, by merely extending in imagination the powers of which we have actual experience, that all geometrical truth in any department might exhibit itself without intermediate steps of demonstration to a mind of sufficient acuteness, when the appropriate definitions had been given. It is conceivable, for example, that when the definition of an ellipse had been given, a Newton might at once conclude the various properties which would be given in a treatise on the Conic Sections.

From geometry we may rise to mechanics. The fundamental proposition expressed by the phrase the *Parallelogram of Forces*, is, as all students know, generally proved upon the basis of certain definitions and axioms, much in the same manner as the fundamental propositions of geometry. Nevertheless I suppose that most minds which have studied mechanics acquire by degrees an almost, if not a perfectly, intuitive perception of the necessary truth of the laws of the composition of forces. To a mind like that of Newton I should imagine that the principles of mechanics would present themselves almost in the same self-evident light as those of geometry. I

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endeavoured many years ago, in a memoir printed in the 'Transactions of the Cambridge Philosophical Society,'[1] to work out in some detail the philosophy of this subject; I grouped together geometry and mechanics as members of a class of sciences which I described as sciences of magnitude and direction; and I argued that as the data of magnitude and direction entirely define a straight line, and the same data entirely define a force, it may be concluded that as two sides of a triangle determine the third side, so two forces represented in magnitude and direction by two sides of a triangle will have for their resultant the force represented by the third.

It is difficult to say to what extent the intuition of mechanical science may be carried. It is quite certain that to those who have thought much on the subject there is no perceptible effort in striding across from the simplest conception of force to propositions which are in a certain sense complicated, and at all events are far from elementary The motion of a particle in a conic section round a centre of force varying inversely as the square of the distance may conceivably be grasped by an acute mind as an axiomatic truth; and if we could only reduce the law of the inverse square (which seems not impossible) to a necessary truth, just as the same law follows by geometrical necessity in the case of illumination from a centre of light, we

[1] The simpler portion of this memoir forms the first essay of this volume.

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might be able to speak of the planetary motions as an elementary truth similar to the propositions of geometry.

Now, it seems worth while to suggest that possibly as the truths of geometry help us to realise those of mechanics, so we may use the truths of mechanics to help us to realise some of the truths of the more subtle sciences, say even that of biology. A remarkable memoir on the 'Theory of Matter,' by the late Robert Leslie Ellis,[1] concludes with the following sentence:—

> I venture to predict, with a degree of confidence which doubtless I shall not communicate to many, that if ever we succeed in establishing a mathematical theory of chemistry, it will be as much conversant with equations of the third or a higher order, as physical astronomy is with equations of the second.

I know from personal intercourse with Ellis that he much prized this prophecy: he said to me that he 'wished it to be remembered.' I am not going to dwell upon it here, further than to remark that the thought expressed by the prophecy seems to me to be capable of being expanded in a form which will well illustrate the view of science that I am endeavouring to express in words. Ellis regards chemical action as the next stage in the complicated kingdom of matter to the action of mechanical forces,

[1] *Mathematical and other Writings of Robert Leslie Ellis*, p. 38.

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and accordingly he assigns to chemistry differential equations of the third order; and every mathematician knows how immense is the increase of complication introduced by the supposed dependence upon these higher equations. But why stop at chemistry? and why stop at equations of the third order? May there not be, or rather is there not, a gradual ascent from the dynamics of matter to the chemistry of matter, from chemistry to biology? And, if there be no prospect of ever reducing biology to mathematical calculation, may we not at least use the conception of a science depending upon differential equations of a high order, incapable of integration, it may be, like some by which we have already been baffled in the sciences of light, heat, sound, and hydrodynamics, for the purpose of illustrating to our minds some of the mysteries and anomalies which the science of life forces upon our consideration?

Let us go back from this transcendental region for a few moments to the consideration of mechanics. We may perhaps rise to it again presently. I wish to endeavour to illustrate the unity and diversity in the difficult department of biology by reference to what is brought before us in the simpler actions of matter.

Let us consider what takes place in the ordinary problem of the motion of a particle round a fixed centre of attraction; the law being the natural one—namely, that of the inverse square of the distance. It

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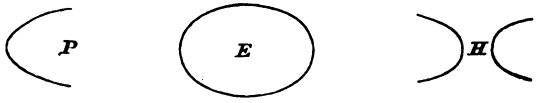
is well known that the path of the particle will be a conic section. To the mind of a geometrician a conic section is a conic section, or an algebraical curve of the second degree; but to an ordinary observer the particle may describe one of three different curves, which to the eye are very unlike each other—a parabola, an ellipse, or a hyperbola; their forms being somewhat as under :—



call them for shortness sake and for reference P, E, and H.

Now a mathematician will be aware that if a large number of particles be projected at random with different velocities about a centre of force, the probability will be that some will describe paths such as P, some paths such as E, and some such as H. If he could observe what took place after such projection, it would not appear to him in any sense strange or anomalous that some of the projected bodies should continue to revolve in orbits nearly circular, and that some should lose themselves in infinite space; on the other hand, he would regard it as practically impossible that all the projected bodies should revolve in nearly circular orbits, and none of them go off upon infinite branches. Therefore, when an astronomer,

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supposed to be also a mathematician, finds by observation that there are a few bodies coursing round the sun in orbits nearly circular, that there are many following very eccentric courses, and many which go off into infinite distance, some having even the double branched course H, of which, however, they can use only one branch, never being able to make any use whatever of the other, he sees in the result a confirmation of the laws of gravitation and of dynamics, and nothing anomalous at all. But suppose that astronomy were simply a science of observation like botany, or anatomy, or biology; suppose that the properties of the conic sections were unknown, and that the curves P, E, H were maintained to be different curves, as certainly to mere ocular observation they would seem to be, would not the system of the heavens present some strange anomalies? Observation first indicates, we will suppose, that certain bodies, the earth amongst them, move round the sun in orbits nearly circular. A speculative mind perhaps asks the reason for this, and many reasons could be assigned, theological, philosophical, or otherwise; and it gradually grows to be the general belief of those who think at all on such matters, that circular motion round the sun is the law of nature. But, then, further observation brings to light the fact that there are numerous bodies which do not conform themselves to this law; bodies which move in curves of exceeding eccentricity, and bodies which move in curves of

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an entirely different character, and which become lost in space. It seems certain that, in the condition of science supposed, these eccentric, and especially the parabolical and hyperbolical, bodies must needs be regarded as anomalous, upsetting all notion of law.

From what has just now been said, it appears to be certainly possible, that in the case of astronomy the mind of a man might pass from a condition, in which the motion of the members of the solar system might be regarded as full of anomaly, to one in which the same motion might present itself as a necessary result of one simple law. May it not be that a similar transition is conceivable in other departments? May there not be differences in the development and results of natural laws, which in reality are not more truly differences than that which exists between an ellipse and a parabola? And if you have a natural result which may be compared to an ellipse, may it not be that in the nature of things the existence of that result is necessarily accompanied by the possibility of other results, which may be compared to parabolas or hyperbolas? To illustrate my meaning, take that view of the world which regards it as above all things the home of intelligent man—surely a very probable and acceptable view to the human mind. The observer who thus regards the world may be compared to the astronomer who regards the solar system as consisting of a few stately spherical bodies, one of which he knows to be inhabited, moving round

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the sun in nearly circular orbits; and to this observer the world will present many anomalies. He cannot account for the existence of much of the inferior department of nature — noxious snakes, mischievous insects, &c. In fact, it is difficult for any one who starts with the simple notion of the world existing for the sake of man, to make out a consistent and tenable theory of nature. But may it not be that the existence of man involves the possibility of snakes as truly and as really as the existence of elliptic motion involves that of parabolical? and may not certain parts of the vegetable and animal kingdoms which appear useless, and the removal of which, we might fancy, would be no disadvantage, or even a theoretical improvement, hold a place similar to that of comets or meteoric stones, which are really inseparable in conception from the more orderly and more apparently useful planets?

There is another consideration which I should like to hang upon the facts of planetary motion. It is possible, and it is said to be the fact, that certain heavenly bodies move in hyperbolas. Let the reader contemplate the figure H; he will observe, what every geometrician knows, that the curve consists of two branches. An unskilled person might possibly speak of them as *two curves*; but they are not two curves, they are only one curve; you can devise no definition, and you can invent no mathematical formula, which will represent one branch without also representing

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the other. Nevertheless, physically, the two branches are distinct; they occupy different portions of space, and if a body be moving in one of the branches it can never by any possibility be transferred to the other. Conceive a body to start in either branch; then it will continue in that branch for ever, its course growing more and more nearly rectilinear, till it ultimately moves sensibly in a straight line. Yet it cannot, so to speak, get rid of all connection with the unused branch; it has never visited it, it never can or will do so, and yet to the mathematician's mind that unused branch is as truly a portion of the body's path as that in which it moves; the unused branch is involved in the definition of the path, and cannot be separated from it.

I have sometimes thought that this view of a planetary path might illustrate other unused things. The nipples and lacteal vessels of male animals, the rudimentary feet of certain snakes, the teeth of whales, and other useless organs of certain living things, may possibly be, like branches of a hyperbola, involved in the definition of the creature, inseparable from its existence, and yet forming no part of its active life. And as the human mind can see the necessity of the existence of the useless branch of the hyperbola, and cannot conceive the elliptic and nearly circular orbit of the earth without recognising at the same time, and in the same effort of thought, the possible existence of useless hyperbolic branches of planetary

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orbits, so it may be that a mind higher than human might see in the definition of man the possible existence of useless organs both in man and in other creatures.

Hitherto I have founded my transference of conclusions from dynamics to sciences not mathematical, such as anatomy and biology, upon the actual case of particles moving round a centre of force varying as the inverse square of the distance. But a further generalisation and further expansion of the speculation which I have been endeavouring to develop, may be usefully and simply effected by considering the case of the motion of particles subject to the action of centres of force of a more complicated kind. It may be that the law of the inverse square is a necessary law of mutual attraction of particles of matter, and that no other is possible; but other laws are conceivable, and the curves described under the action of many laws can be worked out, as any mathematician knows, without any difficulty. For examples, the direct distance, of which we have in fact many actual instances, and the inverse cube, admit of simple solution; and it may be observed that the inverse cube leads to a family of curves more varied than the conic sections, and containing members even more dissimilar one from another than the ellipse and the hyperbola. It is easily seen that the variety of the family of curves will increase in complexity as the complexity of the law of force increases, and

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it is conceivable that there may be a large number of curves which are all essentially one as being the result of the same fundamental physical conditions, and which nevertheless, when graphically traced, may exhibit no apparent resemblance to each other whatever, and would be concluded by any observer, who had only his eyes to trust, to be of altogether alien races. There might conceivably be as much difference between one orbit and another as there is between a vegetable and an animal, or between a bird and a fish.

A still greater variety would be introduced if we developed Leslie Ellis's conception of mathematical chemistry (if there be such a thing), as depending upon differential equations of the third or a higher order. Life, whatever may be its laws and limits, has certainly a much higher basis than chemistry, and may be regarded therefore, as already hinted, as depending for its solution, if on anything, upon differential equations of a much higher order than those which pertain to chemistry. Consequently, the equation of life, if we may venture to speak of such a thing, would be one of almost indefinite complication, involving a vast number of arbitrary constants, from the change of which, according to varying initial conditions, an indefinite number of families of living things would result, producing a most complicated unity, and an almost unlimited variety.

Strange curves would certainly manifest them-

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selves, just as strange species manifest themselves in the departments of vegetable and animal life. Let any one walk through the zoological galleries of a museum and observe the strange reptiles and sea monsters that are collected there: the survival of the fittest scarcely seems to account for the existence of some of them; but I can easily believe that their existence was a necessity, and that they are involved (so to speak) in the general solution of the great life problem.

I am tempted to illustrate the subject which I have in hand by another reference to families of curves. I have dealt with curves hitherto as the paths of particles moving under the action of forces: but an illustration of the unity and variety of nature may be derived from curves, independently of any consideration of physical genesis. The conic sections, for example, are to the mathematician curves corresponding to an algebraical equation of two variables of the second degree. The equation of the second degree has at most only five constants, and therefore its geometrical locus, when the variables are regarded as co-ordinates, cannot be exceedingly complicated. But the equation of the third degree has nine constants, and its locus is therefore immensely more complicated; still more so are the equations of the fourth, and fifth, and higher degrees. Now the variety of planetary motion corresponds, as we know, precisely to the variety of the locus of the equation of

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the second degree; may not some other development of natural forces correspond in variety to the locus of the equation of the third, fourth, fifth, or higher degrees? and may we not gain from our knowledge of the rapidly increasing complications of these families of curves some notion of the necessary variety of the phenomena corresponding to the same development of natural force? The curves of the equation of the third degree have, I believe, never been entirely classified—certainly not those of the fourth and fifth: the rapidly growing complication corresponds admirably well with that which we find in nature.

We may even pursue the illustration of nature by reference to curves a step further. In his clever and eccentric work entitled the 'Ninth Bridgewater Treatise,' Babbage has made use of the points which mathematicians know by the name of conjugate or isolated points, for the purpose of illustrating the relation in which, according to his view, miracles may stand to the ordinary course of nature. These points, as some of my readers will know, and as I may properly explain for the benefit of others, are as much parts of the curve to which they belong as any points in its continuous branches. No definition of the curve can exclude them. Algebraically speaking, their coordinates satisfy the equation of the curve, and therefore they truly belong to it. And yet they stand absolutely separated from the curve's continuous

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branches, and to a mere ocular observer have nothing to do with those branches whatever. Babbage's application of these points to the subject which he had in hand was ingenious and happy; but I wish to borrow his idea for the purpose of this essay, to which it seems to lend itself quite as readily as it does to the illustration of the miraculous.

For instead of the word *miraculous*, which would be altogether out of place in this essay, read *anomalous*, or perhaps more correctly *apparently anomalous*; and we find a good illustration of such apparent anomalies in the conjugate points to which I have referred. Haeckel, for example, tells us that the much-talked-of *purpose in nature* has really no existence, and that, without going more deeply into the matter, the rudimentary organs of animals are a formidable obstacle to the theory; and in the same way he banishes the notion of the *beneficence of the Creator*.[1] Now, if we conceive for a moment, merely as an hypothesis, that nature *has* a purpose, or that it *is* the work of a beneficent Creator, it seems obvious that the expression of that purpose, or the law which expresses the action of that beneficence, must be of a very complicated kind. It seems not unreasonable to compare it to one of the curves of which I have been speaking. Certain anomalies, such as the rudimentary organs, may be conjugate points; they seem utterly inconsistent with purpose; and yet to one who knows the

[1] *History of Creation*, vol. i. p. 19 (English translation).

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equation of the curve, they are as truly part of the curve as the more regular branches; and he will perceive that which the ocular observer does not suspect and cannot believe, namely, that these apparent anomalies and useless excrescences cannot be removed without absolutely destroying the system of which they form a part.

I remember reading many years ago (I think in an early number of the 'Cambridge Mathematical Journal') a paper on conjugate points, which supplies a thought capable of useful application either to Babbage's illustration of miracles, or to that adaptation of his illustration to nature which I have ventured to make. The writer of the paper showed that, under a more general treatment of the equation of a curve, conjugate points might be made to disappear altogether, or, at least, to take their place as points in continuous branches. According to this view the locus of the equation was to be sought not in a single plane, as is commonly done, but in the three dimensions of space; and the writer showed that, according to his method of interpretation, a conjugate point would be the point in which a branch of the curve not lying in the ordinary plane of reference crossed that plane. I think that Babbage might have much improved his illustration if he had happened to be familiar with this idea; he might have argued that a miracle would cease to be a miracle if you could regard it outside the plane of human experience;

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but, leaving out of consideration what Babbage might have done, I should wish to remark, in connection with the subject of this paper, that possibly the anomalies of nature may, like conjugate points, only be so because we are compelled to move (as it were) in one plane, and that, if we were free from the trammels of experience and laws of human thought, we might possibly discover that even the anomalies of nature are part of a continuous and consistent law.

There is one other illustration of the problems of biology which may be drawn from the simpler problem of the dynamics of a particle, and which may be suitably introduced into this essay.

Every mathematician knows that when it is required to determine the orbit of a particle about a given centre of force, the mere assignment of the law of force is not sufficient for the solution of the problem. This assignment will enable him to integrate his equation, if it be integrable; but his integral will contain three arbitrary constants, for the determination of which he will require to know three elements —namely, the distance, the direction, and the velocity of projection. Almost as much will depend upon these conditions of projection as upon the law of force. I have already pointed out that, in the case of the natural law of the inverse square, the path of a particle may be either a parabola, an ellipse, or a hyperbola; and the question which of these the path will be depends upon the conditions of projection, or the initial

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circumstances of motion. Now, in the case of the planets we cannot actually conceive of conditions of projection or initial circumstances of motion ; but we positively know that there must have been something equivalent to these ; there must have been something corresponding to the three data of an ordinary problem in central forces, which fixed the precise orbit of the earth, for example, and determined its eccentricity.

This being realised, let us pass from the known to the comparatively unknown, from *force* to *life*. Let it be granted that all living things have been developed according to some law, not necessarily known, or even capable of description in words, but still a real law of development ; does this give us all the elements necessary for the solution of the life problrm ? If we say *yes*, do we not run into the mistake of a beginner who fancies that he can solve a problem of motion round a centre when he has been told what is the law of force ? Is it not necessary to know the conditions of projection, the initial circumstances of motion or development ? and may not this portion of the data be quite as important as the knowledge of the law of force ?

It seems to me, that they who are most anxious to establish the principle of evolution should be the most ready to perceive the necessity of taking into account the consideration of initial circumstances. It is not a complete account of the earth's motion to say

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that it is the result of gravitation towards the sun. When a body is once in motion, the forces acting upon it may sufficiently account for all subsequent phenomena; but the distance of the earth from the sun, the small eccentricity of her orbit, and so forth, have nothing whatever to do with gravitation; they depend upon quite different causes. You may speculate that the planets were originally rings thrown off from the sun, and thus get one step nearer to the beginning of things; but even then there is no cause which can be assigned why the planets should be situated as they are, and why the conditions of our own planet (to go no further than the body with which we are most familiar) should have been such as they are. Given a slowly revolving mass of cooling vapourous matter, and given the possibility of this mass being transformed into a system of bodies, with the sun in the centre, and the planets revolving round it in orbits nearly circular, they themselves also assuming forms nearly spherical, you still need an initial causation which shall determine the configuration of the system and shall make it to be what it is, and no other.

In like manner a quantity of protoplasm with an assumed power of development will not account for existing forms of life, without the additional hypothesis of some causative power to determine the initial circumstances. Given an original germ, and given some power which shall direct the particular original

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cause of the development of that germ, and the whole subsequent development is conceivable; but the germ and the law of development left to themselves may be as insufficient as the particle and the law of attraction.

This view seems undoubtedly to let in the idea of *purpose* which Haeckel is so anxious to exclude. I do not say that purpose does not come in at an earlier point; but, anyhow, when we come to the consideration of a number of results—all of which are possible under an original law—it would seem difficult to dispense with the supposition of some power, some will, some choice, which has caused one form rather than another to have been adopted in any given part of the kingdom of nature.

Let me add one more suggestion founded upon the supposed analogy between dynamics and biology.

We have seen that the parabola, the ellipse, and the hyperbola are all possible curves for a particle moving round a centre of force. Only one of these curves—namely, the ellipse, and only the ellipse under the condition of small eccentricity, or approximate circularity—can suffice for the orbit of a planet which shall be the home of the highest form of life; namely, that of man. A body moving round a centre of force acting according to the law of the inverse square will not, therefore, form a sufficient definition of a world like our own. The original conditions of motion, the initial circumstances as a mathematician

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would call them, must have been delicately adjusted in order to select, out of all possible forms of orbit, that one circular or nearly circular form which is compatible with the existence, upon the earth's surface, of beings like ourselves. May we not infer from this a similar necessity of original delicate adjustment in the process of the evolution of a highly organised creature from a protoplastic germ? If we are to accept the evolution of man from a germ or seed as a fact of the original Creation, may we not also rightly conclude that the delicate adjustment of the initial circumstances was as necessary in the case of man and his evolution, as it certainly was in the production of that world and its orbit upon which the evolved man was to live?

If there be any validity in the views which have been shadowed forth in this paper, interesting and important conclusions may seem to follow. The general tendency is, I think, to suggest that neither gravitation nor evolution carries us up to the prime cause of existing nature, or renders the hypothesis of such a cause unnecessary. Professor Allman, in the address to which I have already referred, says, I believe with truth: 'The chasm between unconscious life and thought is deep and impassable, and no transitional phenomena can be found by which, as by a bridge, we may span it over.' In like manner, it seems to me that the assertion may be rightly made, that there is a deep, impassable chasm between the

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laws of matter, which have been or ever can be demonstrated, and the prime cause or ground of existence of the material universe. This, however, is a field of discussion upon which I do not desire to proceed in the present essay.

ADDENDUM.

IT was not till after writing the foregoing essay that I became acquainted with the 'Principles of Science' of the late Professor Stanley Jevons. In that most interesting, learned, and suggestive volume, I find much to support the views which I have just put forward. I thankfully quote the following paragraph, which occurs under the title of the 'Indeterminate Problem of Creation':—

'A second and very serious misapprehension concerning the import of a law of nature may now be pointed out. It is not uncommonly supposed that a law determines the character of the results which shall take place; as, for instance, that the law of gravity determines what force of gravity shall act upon a given particle. Surely a little reflection must render it plain that a law by itself determines nothing. It is *law plus agents obeying law which has results*, and it is no function of law to govern or define the number and place of its own agents. Whether a particle of matter shall gravitate, depends not only on the law of Newton, but also upon the distribution of surrounding particles. The theory of gravitation may perhaps be true throughout all time and in all parts of space, and the Creator may never find occasion to create those possible exceptions to it which I have asserted to be conceivable. Let this be as it may, our science cannot determine the question. Certain it is that the law of gravity

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does not alone determine the forces which may be brought to bear at any point of space. The force of gravitation acting upon any particle depends upon the mass, distance, and relative position of all the other particles of matter within the bounds of space at the instant in question. Even assuming that all matter when once distributed through space at the Creation was thenceforth to act in an invariable manner without subsequent interference, yet the actual configuration of matter at any moment, and the consequent results of the law of gravitation, must have been entirely a matter of free choice.'[1]

[1] Page 740 (3rd edition).

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ESSAY III.

GOD AND NATURE.[1]

AN elderly clergyman, dying some years ago in the East of London, bequeathed his silver spoons and the like to his nephews and nieces. But the spoons could nowhere be found. Ultimately they were discovered in a closet beneath a pile of sermons; the good clergyman having, for the sake of safety, chosen for his little stock of plate the place in which, as he imagined, it was most likely to be permitted to remain undisturbed.

I fear that I committed a mistake not long since by doing something analogous to that which was done by him whose providence I have just chronicled, though with a different intention. I printed, in the form of an Appendix to a volume of 'Oxford and Cambridge Sermons,' a Note on 'Matter,' for some portion of which, at least, I should like to crave more consideration than perhaps it has already

[1] Reprinted, with additions, from the *Nineteenth Century* for March 1880.

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received. The following paragraph contains the thought which I wish just now to put before the reader and to develop in this essay :—

'I have referred to Cudworth's discussion of theories of matter with regard to the possible atheistic tendencies of some of them ; and the time has not gone by, perhaps it never will, when the fear of atheism, as growing out of physical theories, will have ceased to exist. I am by no means prepared to say that there is no ground for such fear ; but I think that some portion at least of the danger of science being found to have atheistic tendencies would be got rid of, if a clearer view could be obtained of the manner in which it is possible to establish a connection between physical theories and atheistic conclusions. It seems to me that we want a new word to express the fact that all physical science, properly so called, is compelled by its very nature to take no account of the being of God ; as soon as it does this, it trenches upon theology, and ceases to be physical science. If I might coin a word, I should say that science was *atheous*, and therefore could not be *atheistic* ; that is to say, its investigations and reasonings are by agreement conversant simply with observed facts and conclusions drawn from them, and in this sense it is *atheous*, or without recognition of God. And because it is so, it does not in any way trench upon *theism* or *theology*, and cannot be *atheistic*, or in the condition of denying

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the being of God. Take the case of physical astronomy. To the mathematician the mechanics of the heavens are in no way different from the mechanics of a clock. It is true that the clock must have had a maker; but the mathematician, who investigates any problem connected with its mechanism, has nothing to do with him as such. The spring, the wheels, the escapement, and the rest of the works are all in their proper places somehow, and it matters nothing to the mathematician how they came there. As a mathematician the investigator of clock-motion takes no account of the existence of clock-makers; but he does not *deny* their existence; he has no hostile feeling toward them; he may be on the very best terms with many of them; it may be at the request of one of them, who has invented some new movement, that he has undertaken his investigations. Precisely in the same way the man who investigates the mechanics of the heavens finds a complicated system of motion, a number of bodies mutually attracting each other and moving according to certain assumed laws. In working out the results of his assumed laws, the mathematician has no reason to consider how the bodies came to be as they are; that they are as they are not only is enough for him, but it would be utterly beyond his province to inquire how they came so to be. Therefore, *so far as his investigations are concerned*, there is no God; or, to use the word above suggested, his investigations

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are *atheous*. But they are not *atheistic*; and he may carry on his work, not merely without fearing the Psalmist's condemnation of the fool, but with the full persuasion that the results of his labours will tend to the honour and glory of God.'[1]

The thought contained in this paragraph, and which may be said to be compressed in the word *atheous*, appears to me to be interesting intellectually, and valuable morally. It is not desirable that the reproach of atheism should be thrown about rashly. That there is such a thing as atheism, and that the atheistic condition of mind may be not only a very miserable one, but also a very immoral one, I will not venture to deny; but that charges of atheism are not unfrequently rashly made, and the attitude taken up by scientific investigators is sometimes regarded as atheistic when it is not fairly to be described by that terrible epithet, is also true. Physical science is not more essentially atheistic than arithmetrical or geometrical: all three are atheous, not one is atheistic.

Yet God and nature are very close the one to the other: the *natura naturans* and the *natura naturata* must necessarily be contiguous. We need a 'scientific frontier' between them, a line which shall on no condition be transgressed by those who occupy the territory on one side or the other.

The necessity of keeping this frontier line sacred is perhaps not sufficiently recognised, and there is a

[1] *Oxford and Cambridge Sermons*, p. 280 (George Bell & Sons).

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great tendency to transgress it; but it is not a mere arbitrary line to be laid down by treaty, as the boundaries of adjacent States are settled, but is like one of the great watersheds of nature which no human arrangement can alter; it is like the 'great divide' in the Rocky Mountains, one side of which means for every drop of rain that falls a passage to the Pacific, and the other side means a passage to the Atlantic. On a smaller scale there are similar edges on Snowdon and Helvellyn; you may stand upon them and throw two pebbles with the right hand and with the left, which will be miles apart before they come to rest.

For in truth the difference between the two territories, separated by our supposed scientific boundary, is greater than that which is expressed by the terms *natura naturans* and *natura naturata*.[1] The conception of a *natura naturans* might be merely that of a first cause, a logical beginning of nature, without any of those moral attributes which men with almost one

[1] I have used this phraseology as expressing the difference between the *cause* and the *phenomena* of the material universe. Bacon writes in the first aphorism of the Second Book of the *Novum Organum*: 'Datæ naturæ Formam, sive differentiam veram, sive naturam naturantem . . . invenire, opus et intentio est humanæ Scientiæ.' But upon this Mr. Ellis remarks in a note: 'This is the only passage in which I have met with the phrase *natura naturans* used as it is here. With the later schoolmen, as with Spinoza, it denotes God considered as the *causa immanens* of the universe, and therefore, according to the latter, not hypostatically distinct from it.' As employed by me, the phrase is not intended (I need hardly say) to have any pantheistic tendency.

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consent associate with the name and conception of God. If the transgression of the legitimate boundaries of the field of physical science merely introduced the inquirer to metaphysical speculations, no harm would ensue, though possibly not much advantage. The condition and quality of mind which make a man a successful investigator of nature, either by the way of observation or by that of mathematical analysis, are seldom associated with those mental powers which enable a man to get beneath the surface of phenomena and speculate with any success as to the ground and underlying conditions of things. I do not say that a mind may not possess both kinds of power; but the combination is rare. Still, a man at the worst can only fail, and a brilliant observer or analyst may prove himself to be a poor philosopher, and that is the worst result that can come. But this is not in reality the result of crossing the scientific frontier; if on the one side is God and on the other nature, this means that on the one side you have a moral and religious region, and on the other a purely physical region; and the passage from one to the other is quite certain to be fraught with danger, not to say mischief.

Let me illustrate my meaning by reference to a passage in Ernst Haeckel's 'History of Creation.'

Creation (he writes), as the *coming into existence of matter*, does not concern us here at all. This process, if indeed it ever took place is completely beyond human

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comprehension, and can therefore never become the subject of scientific inquiry. Natural science teaches that matter is eternal and imperishable, for experience has never shown us that even the smallest particle of matter has come into existence or passed away. . . . Hence a naturalist can no more imagine the coming into existence of matter than he can imagine its disappearance, and he therefore looks upon the existing quantity of matter in the universe as a given fact. If any person feels the necessity of conceiving the coming into existence of this matter as the work of a supernatural creative power, of the creative force of something outside of matter, we have nothing to say against it. But we must remark that thereby not even the smallest advantage is gained for the scientific knowledge of nature. Such a conception of immaterial force, which at the first creates matter, is an article of faith which has nothing whatever to do with human science. *Where faith commences science ends.* Both these arts of the human mind must be strictly kept apart from each other. Faith has its origin in the poetic imagination; knowledge, on the other hand, originates in the reasoning intelligence of man. Science has to pluck the blessed fruits from the tree of knowledge, unconcerned whether these conquests trench upon the poetical imaginings of faith or not.[1]

With much which is contained in the preceding quotation I entirely agree. *Where faith commences, science ends*; this is perfectly true; but I miss any recognition of the truth that the supernatural power which most persons 'feel the necessity of conceiving' is something much beyond a 'creative force outside of matter.' It is difficult, I think, for most of us to

[1] Vol. i. p. 8 (English translation).

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keep our minds clear of the conception of such force outside of matter, though I quite agree with the author that nothing is gained for the scientific knowledge of nature by adopting the conception. But what I think the mind feels chiefly the necessity of conceiving is the existence of a Being who is the ground of all the *moral* phenomena of the world; and, if a writer on natural history goes beyond his subject at all, he should recognise the fact that the passing of the boundary carries the mind into a region of moral philosophy and religion, and not merely into a speculation concerning the possible origination of matter.

That this criticism is not unfair and not unimportant may be, I think, concluded from the results to which Ernst Haeckel is himself led, and to which he wishes to lead his readers. He tells us that he has no fault to find with the hypothesis, if we feel it to be necessary, of an origin of matter; but he tells us subsequently that there is no purpose in nature, and no such thing as beneficence on the part of a Creator.

> Every one (he writes) who makes a really close study of the organisation and mode of life of the various animals and plants, and becomes familiar with the reciprocity or interaction of the phenomena of life, and the so-called 'economy of nature,' must necessarily come to the conclusion that this 'purposiveness' no more exists than the much-talked-of 'beneficence' of the Creator. These optimistic views have, unfortunately, as little real foundation

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as the favourite phrase, 'moral order of the universe,' which is illustrated in an ironical way by the history of all nations. The dominion of 'moral' popes, and their pious Inquisition, in the mediæval times, is not less significant of this than the present prevailing militarism, with its 'moral' apparatus of needle-guns and other refined instruments of murder.[1]

This passage, as will be seen, takes us into the region of morals. There is no question here of permitting the hypothesis of an originating force outside of matter, if we feel such an hypothesis intellectually necessary; but we have instead a denial *ex cathedrâ* of the existence of such a thing as a moral order or of such a person as a beneficent Creator. This is not merely *atheous*; it is *atheistic*. An investigator of nature has a right to say that the question of the existence of a beneficent Creator or the non-existence of such a Being does not affect his investigations; but he has no right, upon the strength of investigations purely physical, to deny the existence of beneficence as an attribute of the Creator, if a Creator there be.

But I am not surprised to find utterance given to some expression of opinion as to the moral character of the Creator, when once the legitimate boundary of physical science has been transgressed. If a man can be satisfied with examining nature as he finds it, whether as an observer or as a mathematician, the question of a Creator need no more trouble him than it troubles the man who is busied with integrating

[1] Vol. i. p. 19.

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equations or devising a new calculus; but if he is not satisfied with this, then he can scarcely stop short of a complete investigation of the whole question of Theism; and the elements necessary to this complete investigation are certainly not to be found in physics, any more than you can find in physics the material for a complete treatise on poetry or music or painting.

For, in truth, physical science does not afford the basis even for a complete investigation of ourselves. When *anthropology* is classed amongst the physical sciences, it is necessary to confine the investigations comprehended under the title to the consideration of man as a creature having certain material attributes and leaving certain material marks of his existence in past ages: a study of the highest interest, and one which students have a right to call *anthropology*, if they please: but manifestly anthropology cannot be translated by the words 'the science of man,' for the science of necessity leaves out of consideration all that is most interesting to man or which makes man most interesting.

To say that physical science does not include the study of man is perhaps nearly the same thing as saying that man is not a part of nature; and though such an assertion may seem paradoxical, there is a sense in which it is quite true, and it is important to observe what that sense is. Putting aside all question of immortality, it is not difficult to conclude that mankind possess attributes which do not belong to

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other creatures, and which make it necessary, in examining the world, to put man in a class by himself.

Take a few examples. Let the first be that of will. The question is whether a human being has a command of his actions in a manner in which no other creature has. Simple experience seems to me to prove that he has: I do not feel that I need the help of philosophers to solve the question. A dog or a horse has in a certain sense a will, but I can calculate how a dog or a horse will act, if I know the conditions to which it is subjected; whereas I positively know from actual experience that I can do as I choose, independently of all external influences. Bring me to the test: tell me in any given circumstances what those circumstances will lead me to do, and I will undertake to do something different. And the power of will implies the capacity for self-sacrifice. Every animal is by its very nature selfish. Doubtless there are, in this as in other things, faint reflections of humanity in the humbler creatures, just as the στοργή of the animal, which lasts for a short time and utterly dies out when it has served its purpose, is the faint reflection of that human love which lasts through life and grows with years; but there is nothing in the life of animals which can be seriously named as being of the same kind as that feeling which inspired a Howard, or a Wilberforce, or a St. Vincent de Paul. The man who deliberately puts aside that which is most pleasant to men in general, and which he him-

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self has every capacity to enjoy, and does something quite different from the dictates of his nature because he judges that something to be right or good, exhibits a quality and a power which is simply lacking in every other living creature except the human race.

Again, regard man as a being of purpose. I quoted a passage not long ago from Ernst Haeckel, in which he denies the existence of purpose in nature. Can purpose be denied to exist in man? If I am not mistaken, the whole history of civilisation may be described as a development of purpose. Every other creature is apparently content with the condition in which it finds itself. Birds build nests as their ancestors did thousands of years ago; fishes have no ambition; possibly the time may have been when ants did not know the luxury of keeping aphis-cows, or being waited upon by slaves of their own race; but, speaking generally, it may be said that unprogressiveness marks all other animals, as distinctly as progressiveness does man. I put out of consideration, as not belonging to the argument, the question of evolution, and the progression of living things in that sense of the word. I am speaking only of nature as we see it now, and not as it may possibly once have been; and certainly as things are now, it seems impossible to deny that while the animals about us are as fixed in their habits and instincts as the plants, or nearly so, there is one race, namely, the human, which is not fixed at all, but is constantly devising something new,

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regarding nothing as gained while anything remains to be achieved.

Once more, take the more general attribute of thought. Much has been written of late concerning the minds of animals; it is a curious and interesting subject, and certainly I for one do not grudge our humbler friends in the great world-family of life any gift of mind with which they have been endowed. The brain of the ant is, as some one has truly said, perhaps the most wonderful little morsel of matter in existence. But certainly the mind of man is so incomparably more powerful and effective a machine of thought, that any comparison between it and the mind of the most gifted animal appears almost ridiculous. The fact is that our natural tendency is so much to assume the utter non-existence of mind in animals, that, when we find evidence of mind which we cannot resist, we stand amazed at the discovery. In many things, as we know, the inferior creatures are much more clever than ourselves; we could never build a nest like a bird, or make a comb like a bee, or do ten thousand things which are being done every day by spiders and beetles. But still thought in the highest sense belongs to man. A dog sometimes looks as though he was thinking a thing out, and dog-stories are very wonderful; yet, after all, the cleverest dog that ever lived has never been able to get beyond 'Bow-wow,' and we may safely predict that no dog will ever acquire even the simplest elements of human

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knowledge. I cannot believe that this power of thought can properly be described as the mere result of phosphorus in the brain. That epigram, '*No phosphorus, no thought*,' strikes me as having in it more of smartness than of wisdom. It is of course true that the brain is in some manner the organ of thought, and phosphorus may be the most important element in the formation of the brain; but is not thought conceivable independently of this particular machinery for making it possible to a material creature, just as motion is conceivable apart from horses or steam, or any of the causes to which it is commonly due? Is there not a kind of absurdity in regarding thought as the result of phosphorus, as real as if we should say, what upon the same principle of philosophy we might say, that truthfulness, kindness, modesty were all functions of phosphorus? Nay, I do not know why we should not go further, and assert that there could be no thought without carbon or without any other element of which the human body is composed; for you can have no actual thought without a living creature, and no living creature without a body, and no body without carbon, ∴ &c.—Q.E.D.[1]

[1] I had not observed, when this was written, that the Archbishop of York had said nearly the same thing. 'Without time, no thought; without oxygen, no thought; without water, no thought. All these are true, and they import a well-known fact, that man who thinks is a creature in a material world, and that certain forms of matter are needful to his existence as an organised being.'—*Design in Nature*, 'Word, Work, and Will,' p. 244.

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All these examples lead up to one sovereign attribute which comprehends and implies both them and others equally important, namely, the attribute of personality. A man can say, with a full sense of the meaning of what he says, not merely, 'I eat, drink, and sleep,' nor even 'I am conscious of will, purpose, and thought,' but 'I *am*: I am a conscious person, not a mere machine, though the proprietor of a wonderful piece of machinery. My body, my brain, my mind, are not merely things which work with a living innate power, but they are *mine*, they work for *me*, they do what *I* tell them. If they are out of order, I know it, and I complain of it: I say, for instance, "I have overtasked my brain, I must give it some rest before I can do this or that; I know what I wish to do, and feel myself competent to do it, but my brain will not obey me because it is tired, just as my horse may be overworked, or as my knife will not cut when it has been blunted by too much use."' So of the moral feelings. I can discuss them, I can guide my conduct by means of them, I can feel ashamed of this or that failure in upright or high conduct. A man knows that he is responsible for his actions. Sometimes a murderer is convicted twenty years after the offence has been committed, or he gives himself up after as many years because his memory and his conscience make his life intolerable. He has no doubt as to the fact that the person who did the deed of darkness years ago is the same

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person as he who feels the pangs of remorse to-day. Every material particle in his body may have changed since then ; but there is a continuity in his spiritual being out of which he cannot be argued, even if any ingenious sophist should attempt the task. No ingenuity will prevent the conscience-stricken murderer from pleading guilty.

There are, undeniably, anomalies of a very remarkable kind connected with the sense of personality, and cases are recorded in which men and women have had (as it were) a different personality at different times. An instance is recorded of a young woman who habitually passed from one state of existence or consciousness to another, so distinct that when in the second state she knew nothing of what had happened when she was in the first. For example, having returned upon one occasion from a funeral, she fell asleep, and awoke in a few moments in her second state ; all remembrance of the funeral was gone, and she wondered why she was in mourning. This case appears to have been carefully and scientifically watched for many years, and to have given undeniable evidence of what may be described as a double existence or double consciousness ; so that the being in question would have no true sense of personality, and certainly would not be admissible in a witness-box as evidence of any event said to have taken place.[1] Instances more or less of the

[1] I take this from the *Causeries Scientifiques*, 1877 (Rothschild, Paris).

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same kind may probably be produced without limit. What they prove is that we are dependent for the proper use of our faculties upon material conditions; the *corpus sanum* is one condition of the *mens sana*; but they do not prove the unreality of the attribute of personality any more than the existence of idiocy and insanity, or even the possibility of getting drunk and so losing all sense of who and what we are, prove it. Undoubtedly everything depends, in the case of a human being whose powers are exerted through material organs, upon the proper working condition of those organs; and a pressure of blood upon the brain may make a man of the holiest life and the most philosophical temper commit suicide, as experience proves. But all such morbid exceptions to the general rule cannot destroy the belief, which a man in his normal condition feels compelled by the conditions of his existence to hold, namely, that he is himself and no one else, that he is responsible for his actions, and that what he does now will bear fruit in his subsequent experience either for good or for evil, unless he becomes deranged. The author from whom I have taken the above case of double personality exclaims very naïvely: 'Ah! comme il faut avoir un peu de saine complaisance pour les sept péchés capitaux! Jugez: un peu de sang de trop, peut-être un centième de gramme mal dirigé au contact d'une pauvre petite résille de nerfs, et le voilà fait, l'orgueilleux, le vaniteux, le superbe!' True, we must be cautious in

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forming opinions of actions; and in any human court —we may believe also in the court divine—every circumstance connected with an action must be taken into account in order that a just judgment of it may be formed; but all this does not prove that there is no such thing as haughtiness, or vanity, or pride, or that sane men are not responsible for their temper of mind and the quality of their actions.

To come back then to the conception of personality. I cannot but feel sure that this is the highest conception that I can possess of my own being, or of any kind of being. All history seems to transmute itself into a kind of phantasmagoria or illusive pantomime, unless the attribute of personality be conceded to the actors. Socrates, Alexander, Julius Cæsar, Cromwell, Napoleon, must be studied without reference to phosphorus, and upon principles lying altogether outside the territory of physical science. And this postulate of personality seems to me to lead, by an intellectual necessity, to the conception of personality in a region not of *φωσφόρος*, but of *Φῶς* itself, the conception of *the Person*, *ὁ ὤν*, of whom persons like ourselves are, as it were, a faint reflection.

The study of the being and doings of this Person would seem to be of necessity one of the most interesting that can be suggested to the mind of man. The study may be conducted upon different, though not crossing, lines; the chief lines being the physical, the metaphysical or philosophical, the moral, the re-

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ligious. Each of these branches has its own method and its own sources of illumination: each also has its own peculiar difficulties and its own anomalies and contradictions. A really complete scientific Theism, such a Theism as Bacon would have delighted to map out in detail, would comprehend all the different departments of which I have spoken; and in the unity of such a system physicists and philosophers and divines would be able to meet and shake hands.

It is a curious subject of inquiry, and the reader will, I think, pardon me for here introducing it, how far, upon the theistic view of nature, we can discriminate between that which is necessary in the nature of things and that which is to be regarded as being such as it is in virtue of a divine purpose or choice. It seems clear, for example, that when once matter is assumed to be the subject of a divine operation, as in the case of the universe with which we are acquainted and of which we form a part, certain necessary conditions are imposed upon the creative work or upon the system of nature. These conditions may be, in a certain sense, limitations of divine power: but they are not limitations in any more objectionable sense than are the truths of geometry or number, to which all created things must be conformable. Sometimes a condition of this kind exists which is not at all obvious at first sight, and which, nevertheless, is as necessary to be taken into account as the truth that two and two make four and cannot make five. Thus,

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for example, Laplace suggests that the utility of the moon is not as great as it might have been, and he points out an arrangement according to which, as he shows, the earth would have received much more light than it actually does; but I remember having read a memoir by Liouville in one of the numbers of his *Journal*, in which he shows that the arrangement proposed by Laplace would not be *stable*—that is, that it would only be possible in the sense in which it is possible to make a pin stand upon its point. An example of this kind shows the necessity of caution in any suggestions which may be made for the improvement of natural arrangements. But it does more than this: it helps to illustrate the point which I am now endeavouring to discuss, with reference rather to the philosophy of the arrangements which we see, than to any suggestions for improving them.

Let us consider for a moment what is called by mathematicians the *principle of least action*. Putting this principle into popular language, it may be described as asserting that the motion of bodies generally takes place in such a manner that the energy expended in the motion is the least possible. From this principle, when enunciated in a strict mathematical form, the equations of motion of a system may be deduced, or, in other words, the problem of the motion of a system may be solved. The remarkable fact connected with this principle is,

that its truth was evolved by a speculative mind out of the general principle that nature would use the least effort possible to produce a given result, before it was demonstrated in its strict form by mathematicians; and looking upon it thus, we should be disposed to regard the kind of motion which involves least effort as being chosen out of all possible kinds, much in the same way as a man who has to perform a journey or to do a certain piece of work inquires how the journey or piece of work can be reduced to a minimum of trouble or expense. But the fact of the 'principle of least action' being mathematically deducible from the principles of motion would seem to prove that there is in reality no choice in the matter, but that *least action* is as necessary a truth as is that of the least distance between two points on a sphere being that which is traced by the great circle joining them.

Just consider this question of two points on a sphere. As a matter of geometry it is easy to show that the shortest path between them is that given by the great circle; and this principle is now well recognised in navigation. But change the problem from geometry to dynamics by supposing a particle to move on the surface of a smooth sphere under the action of a force tending to the centre, such as that exerted by an elastic string in a state of tension: then it is equally easy to prove that this particle, when started in any direction, will describe a great circle—that is, its motion will be such that the distance traversed by it

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in passing from its point of departure to any point in its path will be the shortest distance between those points. It might be said that the particle *chose* the easiest path, but in reality there was no choice, nothing but necessity: in other words, the dynamical minimum stands on the same footing as the geometrical.

In truth the question of *minimum* comes under our notice very frequently and very curiously in nature. The path of a ray of reflected light may be determined upon the principle that it is the shortest possible; and this it not the only case in which the law of minimum is illustrated by optics. But take a very different case, that of the cells made by the bee. It is well known that the bee is a wonderful geometer. The cells consist of hexagonal prisms closed at the ends by three tiles having exactly the angles which with a given amount of material will make the cells most capacious, or with a given capacity will use the smallest amount of material. This has been long known, and has given rise to much speculation as to the manner in which the bee is guided to so remarkable a result. I am not aware that any satisfactory solution has been yet proposed; but the intellectual conception of the problem is much simplified if we bear in mind that the transverse section is the nearest form possible to a circle, and the form of the end of the cell the nearest possible to a sphere: so that it may be said that the instinct of making circular pris-

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matic cells with spherical ends, and then clearing away unnecessary wax, is all the instinct which the bee requires. Let the reader observe that this is said not with a view to depreciate the bee's architectural skill, but only for the purpose of pointing out that the application of the wax in the most economical manner, making it go as far as possible, subject to the condition of forming prismatic cells, is a geometrical result from adopting the simplest plane and solid figures, namely, the circle and the sphere. Let me illustrate this by a simple example. Suppose I gave a coppersmith a lump of copper, and said, 'Make this into a bowl of given thickness, having a maximum of capacity:' my coppersmith would undoubtedly be posed. But suppose I said, 'Make this into as simple a bowl as you can, and let the material be of such a thickness:' he would almost certainly make it hemispherical, or nearly so, because that is the simplest form; but his hemispherical bowl would, as a matter of fact, possess the property of maximum content which I wished it to have.

It seems to me, therefore, that there may be not a few cases, in which arrangements, that appear at first sight to be the result of a choice amongst many which might be possible, are in fact arrangements which are necessitated by geometrical conditions, or what may be equivalent to them. This consideration should make us cautious in attributing to an arbitrary will facts which might seem at first sight to warrant this

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conclusion. Then again there are phenomena in the ordinary functions of nature, having the appearance of choice, which yet are not choice in the true sense of the word, but which have strongly the appearance of it, and for which it is difficult to give any account. The manner in which plants turn towards the light is to me a profound mystery ; there must be a force to produce the motion, but I do not perceive whence it can arise. And the instinct of seeking the light sometimes assumes the most wonderful form : I think I have read of a potato in a dark cellar throwing out a long sprout, which extended itself till it emerged at a hole at a distance through which light entered.[1] The power which living matter has to adapt itself to unforeseen circumstances, of which this potato may be taken as a humble instance, has very much of the appearance of choice. A limb is broken, or a skull is trepanned, and the limb becomes as strong as ever, and the skull retains whatever brain it may have had

[1] A correspondent writes to me as follows :—'Adjoining this house is a large, dark, cellar-like outhouse, which is used as a coal-cellar and storehouse for vegetables, &c. A wooden platform has been erected at one corner, raised about three feet above the ground, and covering a space of about nine square yards. Last July I went into this outhouse, and saw, peeping out of a little opening between the front board of the platform and the wall, a few leaves of the halm of a potato. The aperture was about two feet from the ground. I at once took the platform to pieces, and discovered that a stray potato had sent forth four or five shoots, all of which had found their way to the little opening, the only light-hole to the darkness below the platform. The potato was about four feet from the hole ; and the shoots, four feet long, were perfectly white, with little bunches of green leaves only at the aperture.'

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within it, in virtue of new efforts of nature exactly adapted to the wants; but these wants are such as could not have been foreseen, and could scarcely have been included in the original idea (so to speak) of the man to whom the accident has happened.

Therefore I feel that we are on very difficult and mysterious ground, when discussing the place which should be assigned in nature to *choice*. I think that we ought to recognise the fact, that many things in the edifice of nature, which might strike us at first sight as the arbitrary touches of the great Architect, may in reality be the results of geometrical or other necessity inherent in the conditions of space, or time, or matter. Nevertheless, it is difficult to believe that a creation such as we see round about us, and of which we form a part, could have been evolved out of its primitive elements without the exercise of that which, for want of a better word, I will call choice. Why should our hearts be on the left side rather than on the right? Why should we have five digits rather than seven? Why should we have one thumb rather than two? Why, to take a larger instance, should the planets be exactly such as they are in size and in other conditions, which apparently follow no law whatever? Why should the exact quantity of matter exist which does exist, for an infinite quantity is, I suppose, inconceivable? And what determines the precise pace at which all the bodies which constitute the universe move? To use the language of a mathe-

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matician, what determines all the arbitrary constants and arbitrary functions in the integrals of nature's equations? This string of questions might be lengthened indefinitely; but the reader will see what the force of them is. If the principle of symmetry could be asserted concerning the human body or concerning the solar system, that symmetry might answer many questions: it might be said, 'This or that is so, because there is no reason why it should be otherwise.' But there is an absence of symmetry from many parts of nature; and when no geometrical or other cause can be assigned, you need the hypothesis of an independent will in order to render the irregular formation in any degree intelligible. A supreme will throws light upon the darkness; it may leave some difficulties unsolved, yet we feel that in it we have got the key.

But my pen has run as far as perhaps my readers will care to follow me; and I conclude, therefore, by reminding them of the thesis which my essay has been intended to illustrate. It is the relation of God and nature, and the connection between the study of the latter and the knowledge of the former. I would say at the end what I said at the beginning, that physical science is properly and necessarily *atheous*, but not properly and not necessarily *atheistic*. Clerk Maxwell, that great intellect, whom Cambridge and the world have recently lost, was no atheist, but a devout believer in God; yet no man had penetrated

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more deeply and more successfully into the arcana of matter, and discussed more profoundly and more ingeniously the molecules of which the universe is made. Is this wonderful? I think not. It seems to me that, while it is the duty of a scientific inquirer, as such, to exclude from his inquiries anything that at all transcends the natural region, and therefore God can have no place in his inquiries, yet the moral effect of the discipline of investigation ought to be, in the case of a well-balanced mind, to compel it, if need be to 'cross the boundary of experimental evidence,' and recognise the existence of Him 'who hath created all things,' in whom 'we live, and move, and have our being.'

Since writing the preceding essay I have read the chapter, 'God in Nature,' which forms the commencement of the volume entitled, 'Natural Religion.' Anything coming from the pen of the author of 'Ecce Homo' demands respect, and is sure to be widely circulated. I confess, however, that the later volume has not interested me so much, nor appeared to my mind suggestive in the same degree, as the former; and with regard to the chapter bearing a title so nearly coinciding with that of the preceding essay and therefore likely more or less to cover the same ground, I so cordially object to some of the statements made, and to the tone of the statements, that I feel impelled to offer some few critical remarks on the same. I by

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no means intend to examine the chapter in all its bearings, but shall touch only upon certain points. Let me quote a few lines.

> Science opposes to God, Nature. When it denies God, it denies the existence of any power beyond or superior to Nature ; and it may deny, at the same time, anything like a *cause* of Nature. It believes in certain laws of existence and sequence in phenomena, and in denying God it means to deny that anything further can be known.

Now I think that we are entitled to ask when, and where, and how, does science 'oppose nature to God'? Science, by which term I presume is meant physical science, is the knowledge of nature, and as such has no cognisance of God ; science therefore cannot make the opposition attributed to it ; it might as well oppose poetry or painting to nature ; the moment it opposes to nature something which is beyond its province, it ceases to be science and becomes something else. If it be meant that some men who study science 'oppose God to nature,' the statement may be true ; but it is quite different from the assertion that *science* makes the opposition. I use the phrase 'men who study science,' because, if we say, as the author does in a subsequent page, 'the scientific man,' the phrase seems to imply that he does this or that in his character of scientific man, whereas I should earnestly contend that he does it, not in his scientific character but precisely by forgetting that character for a while under some non-

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scientific influence. For example, when Ernst Haeckel writes what I have quoted above, concerning the 'moral order of the universe,' and indulges in a fling at 'moral popes,' and so forth, can any one for a moment maintain that he writes as 'a scientific man,' and not rather as a man who has put his science on one side for a moment, in order to make a raid into a territory which by no means belongs to him? And if it be said that scientific men, as such, do oppose nature to God,' we have a right to ask whether Newton did so, whether Sedgwick, and Whewell, and Faraday, and Clerk Maxwell did so, whether Stokes, and Adams, and Owen, and Paget do so?

What I believe to be the true statement of the case is as follows:—

Science does not, and cannot, oppose nature to God.

Scientific men, as such, do not make the opposition.

Some scientific men do make and have made it; but in so doing they put aside for a time their scientific character, and are led to their conclusions by other than scientific arguments.

As I take exception to what is said of science, so I object to what is affirmed of theology.

The true object of theology, at the beginning, was to throw light upon natural laws; it used, no doubt, a crude method, and in some cases it attempted problems which modern science calls insoluble. Then, when a new method

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was introduced, theology stuck obstinately to its old one, and when the new method proved itself successful, theology gradually withdrew into those domains where as yet the old method was not threatened, and might still reign without opposition. Thus it began to be supposed that law appertained to science, and suspension of law, or miracle, to theology; that the one was concerned with Nature, and the other with that which is above Nature. Gradually the name of God began to be associated with the supernatural, until scientific men began to say they had nothing to do with God, and theologians to find something alien to them in the word Nature.

Let us examine this paragraph. The 'crude method' and the hint about 'attempting problems which modern science calls insoluble,' appear to point to the middle ages, and the unscientific processes of the schoolmen; but if this be so, how can this period of theology be described as 'the beginning'? and giving any meaning we please to this phrase, dating the origin of theology whenever it may seem fit to us, how can we speak of the object of theology being the throwing of light upon natural laws? It seems to me that we may fairly regard the beginning of the Holy Scriptures as the starting point of theology; and if so, nothing can be further from the truth than the assertion that its object is to throw light upon natural laws; nothing can be more striking than the manner in which Holy Scripture, having introduced a picture of creation, of nature, as the platform upon which it is about to build, speedily and for ever dismisses all reference to nature in order to introduce the moral

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relations between God and man, or the human side of theology.

And if, as Christians, we put our origin of theology at the opening of the New Testament, we find as little ground for asserting this strange view of the 'object of theology.' The Incarnation is manifestly the basis of the theology of the New Testament. Whether we look to the history of the Gospels, or the commentary upon the history contained in the Acts and Epistles, or the mysterious chiaro-oscuro of the Book of Revelation, there is not a hint of any intention of throwing the smallest glimmer of light upon 'natural laws.'

If it should be said to be manifest that the author did not take this view of the term theology when he wrote the passage upon which I am commenting, I think I have a right to reply that such a view ought to have been before him. The theology of the opening chapters of the Old Testament, and the theology of every chapter and verse of the New, are protests against that empty kind of theology which in the hands of the schoolmen tended to bring theology into contempt. But theologians are one thing, and theology is another; and as we have no right to say that science asserts this or that, because it has been asserted by men who have studied certain branches of physical science, so we have no right to credit theology with mistakes made, or faults committed, by men who have been known as theologians.

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In the concluding sentence of the paragraph now under consideration I find two difficulties at least. I cannot clearly accept the assertion that 'the Name of God began *gradually* to be associated with the supernatural,' for it seems to me that it is clearly so associated in the first chapter of Genesis, and has been so ever since; and I cannot grasp the meaning of the clause 'until scientific men began to say they had nothing to do with God.' When did scientific men begin to say this? and in what sense did they say it? If they said it as *men*, then it would be a very painful confession of unfaith; but if as *scientific* men, then they might, as I have endeavoured to show in the preceding essay, say it not only harmlessly, but most profitably: the scientific man, as such, *has* nothing to do with God, just as the pure mathematician, as such, has nothing to do with Him. And it seems to me that, until this truth is clearly recognised, we shall always be in danger of misunderstanding. The study and knowledge of nature consist in the observation of facts, and in careful deductions from those facts: the ground of the facts is a different thing altogether. A man may be an excellent observer and an ingenious theoriser concerning observed facts, and yet he may be utterly weak and wandering with regard to moral conclusions and the connection of his facts and theories with theology, or the science of God. Hence, there is much confusion in the following passage,

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which contains, if I rightly judge, the pith of the chapter entitled 'God in Nature.'

If we will look at things, and not merely at words, we shall soon see that the scientific man has a theology and a God—a most impressive theology, a most awful and glorious God. I say that man believes in a God who feels himself in the presence of a Power which is not himself, and is immeasurably above himself—a Power in the contemplation of which he is absorbed, in the knowledge of which he finds safety and happiness; and such is Nature to the scientific man.

Of course anything may mean anything, if we choose so to define it; and the knowledge which a man gains by studying natural phenomena and their laws, may be defined to be an 'impressive theology.' But is it not a somewhat confusing use of terms to describe the contents of Laplace's 'Mécanique Celeste,' or Darwin's 'Origin of Species,' or Sir John Lubbock's book on 'Ants, Bees, and Wasps,' as in any sense theological? If it be meant that the study of nature brings before the mind a very glorious picture of power and wisdom and skill, no doubt the assertion is true; but it does not require a man to be a scientific man to perceive this; in fact, scientific men have sometimes most strangely missed the conclusion; and it may be remembered that it was Bentley, not Newton himself,—the theologian, not the physicist,—who first seized upon the theological side of Newton's great discoveries.

'Such is Nature to the scientific man,' writes the

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gifted author of 'Natural Religion'—they are the last words of his which I shall quote—I cannot but believe that had he been a scientific man himself, he would not have written them. I think he would then have perceived how necessary it is for a man to shut up his scientific books, and to leave his museum and lock his laboratory, in order that he may 'be absorbed in the contemplation of a Power, in the knowledge of which he can find safety and happiness.'

Nature is much to us all: thank God, it is not the monopoly of scientific men. Science has done much for mankind, and will do more still. But when we want to find God in nature, commend me to the poet or the theologian, not to the man of science, as such; nay, I would say commend me to man as man, to man with his sense of weakness and unworthiness, to man with the sense of a great want in his inmost soul which only God can fill, to man made in God's image and conscious of his divine affinity—*he* will find better than any other a witness in nature to the being of 'an awful and glorious God.'

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ESSAY IV.

THE PHILOSOPHY OF CRAYFISHES.[1]

THE publication of Professor Huxley's interesting volume on the 'Crayfish' has probably been the means of making many persons much more intimately acquainted with a creature, best known to most of us as an adjunct to a French dinner, than they ever expected to be. I doubt not that I speak the experience of a multitude of readers when I testify to the pleasure which I have received from the study of the volume. The clearness of description, the excellence of the illustrations, the intelligibility of the whole, leave nothing to be desired. Even the etymology of the name is not neglected, and we find that a crayfish is no fish at all, as in fact even the most ignorant probably suspected, but that *crayfish* is only a corruption of *écrevisse*, and that amongst the functions of this humble crustacean there is possibly to be reckoned the responsibility of keeping in mind the

[1] Reprinted, by permission, from the *Nineteenth Century* for October 1880.

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results of the Norman conquest. It is a striking evidence of the extent and minuteness of modern science that the bibliographical list subjoined to this work contains the titles of some eighty books or memoirs, which may be advantageously consulted by any one who wishes to study more fully the biology of 'crayfishes' after reading all that Professor Huxley's volume contains.

Professor Huxley has written his book on the crayfish as an 'Introduction to the Study of Zoology.' He says in the preface :—

> In writing this book about crayfishes, it has not been my intention to compose a zoological monograph on that group of animals. . . . What I have had in view is a much humbler, though perhaps, in the present state of science, not less useful object. I have desired, in fact, to show how the careful study of one of the commonest and most insignificant of animals leads us, step by step, from every-day knowledge to the widest generalisations and the most difficult problems of zoology, and, indeed, of biological science in general.

I cannot doubt, though I do not speak as an expert, that as an introduction to zoology Professor Huxley's book will be found to be all that he desires that it should be. If it was merely that, however, I should not have thought it necessary to write any remarks upon it. Zoology is not among my studies: I take only that amount of interest in it, which every thoughtful man is sure to take in a subject so comprehensive, and so full of wonder and of beauty. But

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Professor Huxley does in reality suggest thoughts which run beyond the limits of zoological science. His mode of treating his subject leads the mind of the reader, and, as it would seem, intentionally, beyond the region of natural history into the domain of philosophy and even of divinity; and I have been tempted by the study of his book to follow him into this domain, in which I trust he will not regard me as an intruder. I listen with the simple delight of a child to his teaching, so long as it is confined to that which I should describe as his own subject; I venture to doubt and question and criticise, and to suggest thoughts and conclusions of my own, when I find him passing into a region which belongs to me not less than to himself. In fact it is evident that a crayfish may have a place in philosophy, and even in natural theology, quite as assured and as important as that which it holds in science. Those characteristics which have led Professor Huxley to choose this humble living creature beyond all others as a suitable exponent of zoological principles, may also fit it to become suggestive of important thoughts beyond the region of zoology. A crayfish is a more hopeful subject for a philosophical discussion than tar-water. I would that I had Berkeley's power and pen, to enable me to weave 'a chain of philosophical reflections and inquiries,' such as he could have woven, out of the zoological material which Professor Huxley's book supplies. Nay, I should like to get beyond

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mere philosophy, as Bishop Berkeley did when he had only tar-water for his text, into the region of divinity. This may be possible. 'In this mass of nature,' writes Sir Thomas Browne, 'there is a set of things'—why should not the crayfish be one of them? —'that carry in their front, though not in capital letters, yet in stereography and short characters, something of divinity, which to wiser reasons serve as luminaries in the abyss of knowledge, and to judicious beliefs as scales and roundles to mount the pinnacles and highest pieces of divinity. The severe schools shall never laugh me out of the philosophy of Hermes, that this visible world is but a picture of the invisible, wherein, as in a portrait, things are not truly, but in equivocal shapes, and as they counterfeit some more real substance in that invisible fabric.'[1]

The reader will now sufficiently perceive the motive of this essay. In following me through it I should be glad to regard him as having made himself acquainted with Professor Huxley's book; I shall endeavour, of course, to make my remarks so far independent as to be intelligible by themselves, but will not be responsible for the result if they are thus isolated.

The limits of the book extend from the 'Natural History of the Common Crayfish,' which constitutes the first chapter, to the 'Distribution and Ætiology of the Crayfishes,' which constitutes the last. I will make a short extract from each of these chapters in

[1] *Religio Medici*, part i. sect. 12.

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order to define more exactly the beginning and end of our subject.

In Chapter I. we are introduced to the crayfish family thus:—

It is a matter of common information that a number of our streams and rivulets harbour small animals, rarely more than three or four inches long, which are very similar to little lobsters, except that they are usually of a dull, greenish, or brownish colour, generally diversified with pale yellow on the under side of the body, and sometimes with red on the limbs. In rare cases their general hue may be red or blue. These are crayfishes, and they cannot possibly be mistaken for any other inhabitants of our fresh waters.

And the following is the penultimate paragraph of the last chapter:—

Thus, with respect to the ætiology of the crayfishes, all the known facts are in harmony with the requirements of the hypothesis that they have been gradually evolved in the course of the mesozoic and subsequent epochs of the world's history from a primitive astacomorphous form.

These two paragraphs sufficiently define, as I have said, the beginning and the end of our subject; but I will subjoin the concluding paragraph of the book, as it should be read in conjunction with that just quoted, and because I shall have occasion to refer to it hereafter.

And it is well to reflect that the only alternative supposition is, that these numerous successive and coexistent forms of insignificant animals, the differences of which require careful study for their discrimination, have been separately and independently fabricated, and put into the

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localities in which we find them. By whatever verbal fog the question at issue may be hidden, this is the real nature of the dilemma presented to us not only by the crayfish, but by every animal and by every plant; from man to the humblest animalcule; from the spreading beech and towering pine to the *Micrococci* which lie at the limit of microscopic visibility.

Let us now examine some of the characteristics of the crayfish, choosing those which will subserve the general purpose of this essay.

The animals may be seen walking along the bottom of the shallow waters which they prefer, by means of four pairs of jointed legs; but, if alarmed, they swim backwards with rapid jerks, propelled by the strokes of a broad, fan-shaped flapper, which terminates the hinder end of the body.

They are intolerant of great heat, and of much sunshine; they are therefore most active towards the evening, while they shelter themselves under the shade of stones and banks during the day.

So long as the weather is open, the crayfish lies at the mouth of his burrow, barring the entrance with his great claws, and with protruded feelers keeps careful watch on the passers-by. Larvæ of insects, water-snails, tadpoles, or frogs, which come within reach, are suddenly seized and devoured, and it is averred that the water-rat is liable to the same fate.

These facts would seem to indicate that the crayfish has his likes and dislikes in a manner similar to that observable in creatures of a higher type. They do not prove, of course, that the sense and sensibility of a crayfish are equal to those of a human creature; but they are capable of the simplest explanation upon

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the hypothesis, that the lower animal possesses in a rudimentary form that which is more completely possessed by the animal of higher organisation. Indeed, the language used by Professor Huxley, taken in its ordinary meaning, plainly implies an explanation of this kind; he speaks of the crayfish *preferring* shallow waters, being *alarmed*, being *intolerant of heat*, *keeping careful watch* when hunting for its prey. It will be seen, however, from a subsequent and more careful statement, that the reader is not intended to draw the conclusion that the outward demeanour of the crayfish does in reality represent conduct conditioned by the same kind of motives as those which are implied by the popular language above quoted.

If the hand is brought near a vigorous crayfish, free to move in a large vessel of water, it will generally give a vigorous flap with its tail, and dart backward out of reach; but if a piece of meat is gently lowered into the vessel, the crayfish will sooner or later approach and devour it. If we ask why the crayfish behaves in this fashion, every one has an answer ready. In the first case, it is said that the animal is aware of danger, and therefore hastens away; in the second, that it knows that meat is good to eat, and therefore walks towards it, and makes a meal. And nothing can seem to be simpler or more satisfactory than these replies, until we attempt to conceive clearly what they mean; and then the explanation, however simple it may be admitted to be, hardly retains its satisfactory character.[1]

Professor Huxley then argues that the crayfish cannot say to himself 'This is dangerous,' 'That is

[1] Chapter vii.

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nice,' being devoid of language; that the crayfish cannot frame a syllogism; that experiments upon animals have proved that consciousness is wholly unnecessary to the carrying out of many of those combined movements, by which the body is adjusted to varying external conditions. Hence the conclusion is reached that 'it is really quite an open question whether a crayfish has a mind or not.' It is added that 'the problem is an absolutely insoluble one, inasmuch as nothing short of being a crayfish would give us positive assurance that such an animal possesses consciousness.'

This may be all in a certain sense true, but it seems to me to involve not a little mystification. If nothing short of being a crayfish can give us positive assurance that such an animal possesses consciousness, the same proposition must be true of a dog or a horse: and yet, in the case of animals of such organisation as those just mentioned, I think it would be hypersceptical to question the possession of consciousness analogous to our own; and few persons would be found who would be content to regard the existence of mind in a dog as 'an open question.' Is it not somewhat unfair to the crayfish to bring his actions and habits, without any intermediate steps, into comparison with those of man, and so reduce his mind (as it were) to zero by comparison? Would it not be more philosophical to begin with man, from whose constitution we first derive the conception of

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mind, and then proceed from him gradually downward in the scale of being? It is difficult to say which creature is nearest to man. If we regard physical form only, doubtless apes and monkeys are our closest neighbours, and I presume that no one will deny these cunning animals the possession of mind; but it is equally difficult to deny this in the case of such animals as elephants, horses, dogs. There is scarcely any creature that cannot be tamed, and which does not in its tamed condition exhibit sympathy with man. Does not this indicate a mental tie between us? And the same remark applies to birds; apparently to snakes and reptiles. I have neither knowledge nor space to follow this line of thought into all the region into which it might lead us; but the general conclusion which I wish to suggest is this, that if we begin with the creatures nearest to man and observe how mental qualifications shade off gradually from them as we pass to those which are lower down in the scale, it is difficult and perhaps impossible to say where mind ceases and where life without mind begins. Consequently, if I find a crayfish doing things which a human creature would do under similar conditions, I think that he may be credited with doing those things for similar reasons. You cannot prove that it is so, but the crayfish seems to be entitled to the benefit of the doubt. If he exhibits signs of fear, pleasure, preference, and the

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like, why should he not be concluded to possess those feelings of which he exhibits the signs?

The crayfish has the more right to this liberal treatment, because he possesses the physical organ of mind—that is, a brain. Professor Huxley tells us not only that he has a brain, but that he behaves himself in a very abnormal manner when his brain is removed;[1] he becomes in fact deranged. He does not cease to live, as I suppose a brainless man would, but he is as evidently dependent upon his brain for the orderly regulation of his conduct as the higher animals, or as man himself. Having, therefore, the physical organ of mind, and comporting himself as creatures do which confessedly are possessed of mind, I see no good reason to doubt the existence in the crayfish, in a very humble form of development, of a power which may rightly be described as mind.

This conclusion having been reached, I think it is highly interesting to reverse the process of the study of mind, and regard the early developments of mental power as types and foreshadowings of the grand development of the powers of thought, which was to crown the natural history of the world in the appearance of man upon the globe. Time was, I suppose, when the crayfish, instead of being the humble creature which he now is, was high up in the organic scale; conceivably he might be amongst the highest creatures; and if so, it is curious to think of the

[1] The *Crayfish*, p. 110.

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manner in which his habits and tastes foreshadowed those of far higher creatures still, which were to be developed in the fulness of time. The crayfish lying in ambush for his prey, and apparently finding his chief pleasure in this occupation, might seem to indicate the existence, even in the earlier forms of life, of that love of sport which belonged to our rude forefathers, and which few Englishmen have sloughed off even in these days of books and physical science.

A whole volume of curious speculation is bound up in the thought, that the habits and tastes of the early inhabitants of the globe may be found developed in the human epoch and connected with the laws of civilised men. Certainly the catching of prey, which occupies the crayfish, and which is evidently not only a necessity of existence but a positive source of delight to higher animals (witness dogs and cats), has had much to do with the course of human history, as it has now with the pleasure and occupation of multitudes. The same remark may be made concerning the bellicose character of many among the lower creatures; this finds itself repeated in the love of war, which certainly is a great feature of the human character and has had more to do with the history of nations than almost anything else. And, to take quite a different example, we find in the natural history of sex, even among such humble creatures as the crayfish, the type of that which is the basis of human society and the spring of civilisation. It requires a long

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stride of the imagination, but it is a possible stride, to carry us from the thought of what may be called in a humble sense the family life of crayfishes to that of the consecrated tie of man and woman, and the corollaries which follow from it in the complicated machinery of human life and society.

I have spoken of the habits and tastes of the earlier creatures as typifying and foreshadowing that which should come to pass later on; but I do not perceive how the latter could be evolved out of the former by any necessary process, nor do I see any reason to conclude that such evolution actually took place. I mean that a crayfish, in those days in which he was at the head of creation, would seem to be the same thing that a crayfish is now. If a fossil crayfish could be brought to life again, he would presumably be as highly endowed as a crayfish of the present day. The crayfish was 'gradually evolved in the course of the mesozoic and subsequent epochs of the world's history from a primitive astacomorphous form,' but when so evolved he became a crayfish, and nothing more; and if the world lasts for a hundred million years longer, I presume he will be a crayfish still. There is what I will venture to call a mysterious unity connecting him with ourselves. He has true blood, a real heart, machinery of digestion, even eyes, ears, and the sense of smell, like ourselves; but he has radiated from the primitive protoplasm, if that be a correct phrase, in a different direction from that assumed (for example)

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by mammals or by man, and his path of life must for ever remain distinct. Unity with mammals and diversity from them may be predicated of the crayfish, one as distinctly and as truly as the other.

Which remark may be illustrated by reference to one of the most obvious characteristics of the crayfish and of the class to which he belongs. He is a crustacean: that is to say, he is enclosed by a hard shell, which protects his muscles and all his softer parts at every point, and serves him as a coat of armour. It seems to me impossible to conceive of any natural process, by which a creature of this kind could ever be transformed into a mammal or a fish. I do not imagine that any really scientific man would allege such possibility; though I suspect that the doctrine of evolution, to the minds of many persons, means that anything can become anything else, if you only give it time enough. Anyhow, the development of a crustacean into a fish or a mammal may, I think, be regarded as an impossibility. And yet, if the difference between the two be scientifically considered, it may be made to assume very small dimensions indeed. It is simply a question of a skeleton inside or a skeleton outside.

Probably the most conspicuous peculiarity of the crayfish (writes Professor Huxley) to any one who is familiar only with the higher animals, is the fact that the hard parts of the body are outside and the soft parts inside; whereas in ourselves, and in the ordinary domestic animals, the hard parts, or bones, which constitute the skeleton, are inside,

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and the soft parts clothe them. Hence, while our hard framework is said to be an *endoskeleton*, or internal skeleton, that of the crayfish is termed an *exoskeleton*, or external skeleton.[1]

How simple the difference seems! It gives rise, no doubt, to an entirely different set of habits, an utterly different external appearance, and a different set of kinematical and mechanical problems in the construction of the animal; but, looking upon the various constituent elements of creation as bound together in unity by some quasi-mathematical formula, we may say that the difference between an exoskeleton and an endoskeleton is merely the difference of a mathematical sign, the substitution of a *minus* for a *plus*. Every mathematician knows the marvellous changes which result from a change of sign: the substitution of a *minus* for a *plus* in a differential equation will introduce exponential forms instead of sines and cosines into the integral, and so produce quite as great a difference as that which separates crustaceans from mammals. Creatures which in human observation are widely, almost infinitely, divided, may in divine geometry be one. I may add that a similar mathematical unity with phenomenal diversity exists in the case of exogenous and endogenous plants; nay, it may be a question whether the distinction of sex may not be regarded from the same point of view.

The external position of the skeleton of crayfishes

[1] The *Crayfish*, p. 17.

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leads to a distinction between them and animals of the endoskeleton type of a very marked kind. The crayfish casts its shell, or skeleton, from time to time, and generates a new one; the skeleton will not grow, as in the case of the higher animals; consequently the whole of the old coat of the body is thrown off at once, and the new coat which has been forming under the old one is exposed, and hardens, while the body of the crayfish rapidly increases in size. The process is a curious one, involving great exertion on the part of the crayfish, which, after the work is completed, lies in a prostrate condition, exhausted by its violent struggles. The effort of exuviation, Professor Huxley tells us, is 'not unfrequently fatal.' One scarcely knows whether to wonder more at the strange law which compels a creature to undergo at intervals such a process of regeneration, or at the remarkable arrangement by means of which the universal principle of growth is enabled to assert itself under the difficult conditions of a body contained in a rigid envelope. My chief reason, however, for laying stress upon exuviation as one of the phenomena of crayfish life, is that it seems to emphasise the difference between creatures with exoskeletons and those with endoskeletons, while at the same time it does not obliterate the unity which joins one class with the other. The unity is more and more pronounced the more carefully we examine and discuss it; but also it becomes more and more inconceivable that there should not

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be a radical and aboriginal diversity, which cannot be obliterated by any natural process, evolutionary or otherwise.

The crayfish is endowed with organs corresponding to the senses of sight, hearing, taste, and smell. The eye is in fact an instrument of a very complicated character, and, though strikingly different from the eyes of mammals, has nevertheless that same kind of unity in diversity which we have noted in the matter of the skeleton.

It is wonderfully interesting to observe (writes Professor Huxley, after an elaborate description of the eye of the crayfish and the theory of what is called *mosaic vision*) that, when the so-called compound eye is interpreted in this manner, the apparent wide difference between it and the vertebrate eye gives place to a fundamental resemblance.

The ear is a somewhat simpler piece of machinery, but apparently well adapted for its purpose.

Sonorous vibrations are enabled to act as the stimulants of a special nerve connected with the brain, by means of the very curious *auditory sacs* which are lodged in the basal joints of the antennules.

And again :—

The sonorous vibrations transmitted through the water in which the crayfish lives to the fluid and solid contents of the auditory sac are taken up by the delicate hairs of the ridge, and give rise to molecular changes which traverse the auditory nerves, and reach the cerebral ganglia.

Granting the crayfish the existence of organs for seeing and hearing, such as here described, we may

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assume, so far as my purpose is concerned, that it possesses those which are connected with the less exalted senses of taste and smell.

The question arises, what conclusions can be fairly drawn from the existence of eyes and ears, and from the conduct of crayfishes as depending upon the senses of seeing and hearing? Professor Huxley writes as follows :—

> Thus the crayfish has, at any rate, two of the higher sense organs, the ear and the eye, which we possess ourselves ; and it may seem a superfluous, not to say a frivolous, question, if any one should ask whether it can hear or see.
>
> But, in truth, the inquiry, if properly limited, is a very pertinent one. That the crayfish is led by the use of its eyes and ears to approach some objects and avoid others is beyond all doubt ; and, in this sense, most indubitably it can both hear and see. But if the question means, Do luminous vibrations give it the sensations of light and darkness, of colour, and form, and distance, which they give to us? and do sonorous vibrations produce the feelings of noise and tone, of melody and of harmony, as in us? it is by no means to be answered hastily, perhaps cannot be answered at all, except in a tentative, probable way.

And again :—

> At the most, we may be justified in supposing the existence of something approaching dull feeling in ourselves ; and, to return to the problem stated in the beginning of this chapter, so far as such obscure consciousness accompanies the molecular changes of its nervous substance, it will be right to speak of the mind of a crayfish. But it will be obvious that it is merely putting the cart before the horse, to speak of such a mind as a factor in the work done

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by the organism, when it is merely a dim symbol of a part of such work in the doing.[1]

I venture to question the philosophy which is here propounded. The conclusion which we are asked to accept is that all the actions and behaviour of a crayfish are the necessary results of the material organisation of the animal, or of the action of external causes upon that organisation. Of course it will be allowed at once, that the organs of the crayfish perform only in a very humble and limited manner and degree the offices performed by the corresponding organs in ourselves. The crayfish's eye has, as we may well believe, no sense of the beauty of the objects by which it is surrounded, and his ear has no musical pleasure in the sounds which it transmits; and, therefore, if by seeing and hearing we mean the enjoyment of the higher functions of the eye and ear, we may deny seeing and hearing to crayfishes, as we may in fact, though in a less degree, to horses and dogs. But when I am led from this obvious admission to the conclusion that the mind of a crayfish, in the sense in which mind can be predicated of such an animal, may not be admitted as a factor in the work done by the organism, I rebel against my leader. If I grant this conclusion, it seems to me that I grant a more completely materialistic theory of the crayfish than I am justified in granting. I see no reason to suppose that the crayfish does not, for example, take

[1] The *Crayfish*, p. 127.

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pleasure in what he does: a low and simple pleasure doubtless, but still a true and real pleasure, such as his organisation renders possible. When he lies at the entrance of his house watching for his prey, I see no reason to suppose that he does not take delight in his occupation. But *pleasure* in doing this or that is something quite distinct from 'work done by an organism;' and if pleasure of some kind be denied to the crayfish, contrary to all appearances, I do not know at what point in the scale of animal life pleasure is to be admitted as a factor. If to speak of mind as a factor in work done be an absurdity in the case of a crayfish, is it not an absurdity in the case of a dog, or even in the case of a man?

It seems to me that the question thus raised is of fundamental importance. Is mind a cause or an effect? Is there something connected with life which actuates the physical organisation, or is mind merely a word which expresses the results to which the physical organisation gives rise? The two hypotheses are the exact opposite of each other. Both cannot be true: the former is that which we should infer from our own experience, and I think from general reasoning; the latter has some appearances in its favour, but is destructive of all the highest conceptions of mind to which the mind's reflection upon itself has given rise. *Tua res agitur, paries cum proximus ardet.* There are not so many partition walls between ourselves and the crayfishes. I cannot afford to re-

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gard the doings of my humble neighbour as merely mechanical. He has his likes and his dislikes, his pleasures and his pains, his fancies and his fears; and though the distinction between him and a moral, responsible being like man be well-nigh infinite, still his little rudimentary mind must not be regarded as a mere result of physical organisation (unless, of course, demonstrative proof can be given), lest the concession made in respect of our humble neighbour should be found to compromise our own most precious possessions.

While accepting, therefore, thankfully Professor Huxley's physical investigation of the eyes and ears of crayfishes, I venture to question his philosophical conclusions concerning mind and matter, as to which is cart and which horse. I demur in like manner to the view given as to the teleology of the crayfish, and by implication as to teleology in general. The late Professor Willis was wont to devote one of a course of lectures on practical mechanics to the description and discussion of the claw of a lobster: he used to demonstrate, with reference to an actual claw, various geometrical and mechanical problems which were solved by natural mechanics. I do not remember that he used to 'improve the occasion,' but he certainly left upon the minds of his pupils the impression that the lobster's claw had been devised by a high intelligence with marvellous skill, for the purpose of performing certain functions for the benefit

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of the creature to whom the claw belonged. There are many passages in Professor Huxley's book which indicate, as we might have anticipated, that he also is keenly alive to the beauty of the mechanical arrangements in the crustacean organisation. For example, after describing one such arrangement in what he calls 'the gastric mill' of the crayfish, he writes thus :—

> Works on mechanics are full of contrivances for the conversion of motion ; but it would, perhaps, be difficult to discover among these a prettier solution of the problem : Given a straight pull, how to convert it into three simultaneous convergent movements of as many points.

This is language of high appreciation ; it seems almost to force the mind of the reader to some such conclusion as that which Paley would have appended to it ; and in proportion to the pleasure with which I listen to such language is the disappointment which I feel in reading such a passage as the following :—

> In the two preceding chapters the crayfish has been studied from the point of view of the physiologist, who, regarding the animal as a mechanism, endeavours to discover how it does that which it does. And, practically, this way of looking at the matter is the same as that of the teleologist. For, if all that we know concerning the purpose of a mechanism is derived from observation of the manner in which it acts, it is all one, whether we say that the properties and the connections of its parts account for its actions, or that its structure is adapted to the performance of those actions.
>
> Hence it necessarily follows that physiological pheno-

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mena can be expressed in the language of teleology. On the assumption that the preservation of the individual and the continuance of the species are the final causes of the organisation of an animal, the existence of that organisation is, in a certain sense, explained, when it is shown that it is fitted for the attainment of those ends, although, perhaps, the importance of demonstrating the proposition that a thing is fitted to do that which it does is not very great.[1]

The effect of this passage would seem to be to do away with teleology altogether; and to do away with teleology is to banish the ultimate conception of a creating mind. Hence I must demur to the conclusion, that there is not much importance in demonstrating that a thing is fitted to do that which it does. The truth or falsehood of this conclusion depends upon the purpose proposed in the demonstration. You come down some morning and you find that your house has been robbed; searching about, you find an instrument which is strange to you; the police inspector at once recognises it as a housebreaking implement; he explains to you how it works and shows you precisely what the action of the thieves has been. What would the inspector think if you should say, 'Perhaps the importance of demonstrating the proposition that this thing is fitted to do that which to my cost I know it has done, is not very great'? The discovery of the tool adapted to its purpose is manifestly a revelation as to the mind which contrived the robbery; it tells you something

[1] The *Crayfish*, p. 137.

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at least as to the person who did it ; it shows that the robbery was not the result of the organisation of your own household, that the loss of your money was not accidental, and so forth.

The fact is that 'the importance of demonstrating a proposition' depends upon the point of view from which the proposition is regarded. If I am a passenger in a steamer and I cross the Atlantic in twelve hours' less time than it has ever been crossed before, it may be of little importance to me to demonstrate that my passage is the shortest on record. I have kept my appointment, done my business, had my pleasure, or what not, and there is an end of it. But how with regard to the man who built the ship? Is it nothing to him to demonstrate that the ship was fitted to do that which she did—that it was not the result of accident, or even the will of the captain and crew, but the necessary consequence of some ingenious improvement in machinery which he (the builder) had cunningly devised and had introduced for the first time?

And so in the case of the crayfish. If the animal be regarded merely as an organism, it may be useless to demonstrate that its parts are fitted to do the things which they do ; but if I wish to look beyond the mere organism—which I have a good right to do, and as a philosopher am bound to do—then the adaptation of means to ends, the ingenuity of mechanical contrivances, the whole life and organisation of the

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animal, are worthy of deepest consideration, as indicating the action of the mind from which the conception of living material organisation originally sprang: just as a steam-engine may lead a man's thoughts to the genius of James Watt, or a picture may fill the mind with wonder at the power of Raffaelle, or St. Paul's may suggest the greatness of Sir Christopher Wren.

Nor can I pass away from the remarks which I have quoted on the subject of teleology, without objecting to the suggestion that the *τέλος* of an animal is 'the preservation of the individual and the continuance of the species.' That these are things for which, in the economy of nature, provision is made, will of course be granted; but to assume them to be '*the* final causes of the organisation of an animal,' is, I think, to go beyond anything that we are in a condition to prove. Are these the final causes of *human* organisation? I am at this moment using my right hand for the purpose of guiding my pen, my left for holding my paper, my eyes for watching what I am doing, my brain for considering what I shall indite; what have all these things to do either with the preservation of an individual or the continuance of a species? But if this account of the final causes of organisation utterly breaks down in the case of a man, why should we assume its truth in the case of a lower animal? Even in the example of the crayfish I should demur to such a view of his final cause. I see nothing irra-

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tional in supposing that the pleasure which the crayfish seems to find in his existence, his habits of hunting, the society of his kind, and the like, may be regarded as truly in the light of ends as analogous things may be in the case of higher animals. I should be sorry, however, to dogmatise upon a point of this kind. I have great doubt as to whether we can properly speak of final ends at all, unless we embrace in our conception the whole cosmos. Crayfishes may be a necessary link in the order of creation; it may be that their *raison d'être* cannot be explained apart from the existence of the whole creation of which they form a humble part; but if we are to speak of final causes, I think we are bound not to limit the conception of cause simply to that of preservation of individuals or species—we should go at least one step further, and consider for what end they are preserved.

And here I would venture to offer a few speculative thoughts concerning this end. I imagine that if it be possible to present a complete and satisfactory theory of the *τέλος* of the material universe, it can only be done from the standpoint of Revelation; and to deal with the subject in that sense would be entirely alien to the character and purpose of this essay. But, without attempting a complete theory, I think it may well be urged that one considerable portion of the end for which living things may be conceived to exist is to be sought in the amount of enjoyment of which those

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living things are susceptible.[1] It has often suggested itself to my mind, that the mere existence of life may be a source of almost unlimited delight. It is difficult from an analysis of our own sensations to arrive at any very distinct conclusion as to what are the sensations of the lower creatures. Man is in every sense so exceptional a being, so infinitely removed from all other living things in his power of doing and enjoying and suffering, that it is difficult to argue from him to anything below. Nevertheless it may be possible to bridge over the gap to some extent, and guess at least at the inner life of our humbler fellows. For example, when a young man is in full health and strength, and when he is in active exercise, climbing a hill or engaged in some athletic sport, is not his mere existence a source of pleasure? The blood leaps in his veins, his lungs swallow in the fresh air, every function goes on without effort or friction, and life itself becomes a joy. May it not be thus constantly with creatures which are always in perfect health and are absolutely free from care? May there not be, as certainly there seems to be, an indefinite amount of joy in life itself to beasts and birds and fishes, and may not the sum of this joy be one of the ends for which they exist? May we not also be assisted in speculating upon the possible pleasure in life enjoyed by creatures inferior to ourselves, by reflection upon

[1] On the subject of pleasure experienced by living organisms, as part of the economy of nature, I would refer to the characteristic and striking remarks of Paley, contained in chapter xxvi. of the *Natural Theology*.

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a condition which I suppose we have all experienced? I refer to the half-asleep half-awake state of consciousness in which we sometimes find ourselves after a night's rest: the mind has not reassumed its activity, cares have not begun to press, the whole situation is one of dreamy comfort and passivity. May not this condition more or less correspond to the normal condition of some at least of the inferior animals? A horse stands in a stall, tied by the head, in a manner which would be intolerable if his mind were capable of high action, and which would drive a human being crazy; and yet he seems placidly happy. May it not be that his mind is sufficiently developed to enable him to enjoy the same kind of dreamy existence, which a man enjoys when half asleep? and may we not gain from the lower levels of our own experience guesses concerning the pleasures, which may be possibly found in the normal condition of creatures infinitely inferior to ourselves? Anyhow, it seems to me that there is abundant ground for a more or less confident persuasion that, upon the whole, enjoyment of life is the rule of animal existence, and that the fact of this enjoyment should be taken into account in any teleological speculation.

But I must pass on to consider the subject with which Professor Huxley deals in his concluding chapter, and which, from the point of view of this essay, is a most important one—the ætiology of crayfishes.

Ætiology is a word concerning the meaning of

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which as applied to crayfishes or other animals there might be some doubt. The meaning assigned to it by Professor Huxley may be gathered in general from a paragraph, in which he speaks of the final problem of biology as being that of 'finding out *why* animals of such structure and active powers [as crayfishes], and so localised, exist.'[1]

Passing from the general to the particular, we find the question of the *why* represented as lying between two hypotheses, that of creation and that of evolution. From a scientific point of view the adoption of the speculation of creation is regarded as 'the same thing as an admission that the problem is not susceptible of solution.' Moreover, 'apart from the philosophical worthlessness of the hypothesis of creation, it would be a waste of time to discuss a view which no one upholds.' 'Our only refuge, therefore, appears to be the hypothesis of evolution.'

Now I am not intending to say a word in favour of creation as against evolution; but I should like to ask, Are they in any way alternative hypotheses? are they even *in pari materie*? Undoubtedly no reference to creation or creative fiats can occur in a scientific treatise; but this does not prove that in its proper place a reference to creation may not be a very proper thing. A child is taught in its first catechism, in answer to the question, 'Who made you?' to say 'God.' Does the answer present itself as either un-

[1] The *Crayfish*, p. 317.

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philosophical or false, when in due time the child learns the process of evolution by which it came into the world ?

Hence, while willing to follow a scientific teacher in the pursuit of such knowledge as he can give me with regard to the past history of living things, I reserve the right of believing in creation as well as evolution, if I find sufficient grounds for such belief. And indeed I am utterly unable to perceive how the necessity of belief in something, which I trust I may without offence call creation, is dispensed with by Professor Huxley's ultimate conclusion on the subject of the ætiology of crayfishes. I have already quoted the last two passages of the book;[1] let the reader bear these passages in mind. The solution of the crayfish problem is found in 'the hypothesis that they have been gradually evolved in the course of the mesozoic and subsequent epochs of the world's history from a primitive astacomorphous form.' And then we read that 'the only alternative supposition is, that these numerous successive and co-existent forms of insignificant animals, the differences of which require careful study for their discrimination, have been separately and independently fabricated, and put into the localities in which we find them.' Surely this statement is a little unfair. Who talks of independent *fabrication* and of *putting* animals into *localities*? And even if a speculator should be convicted of such

[1] See p. 83.

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language, might he not very well ask, What of the 'primitive astacomorphous form?' how did that form get into its locality? whence and how did it acquire its power of evolution, from which such wonderful results have followed? Professor Huxley speaks of a 'verbal fog by which the question at issue may be hidden:' is there no verbal fog in the statement that *the ætiology of crayfishes resolves itself into a gradual evolution in the course of the mesozoic and subsequent epochs of the world's history of these animals from a primitive astacomorphous form*? Would it be fog or light that would envelop the history of man, if we said that the existence of man was explained by the hypothesis of his gradual evolution from a primitive anthropomorphous form? I should call this fog, not light.

It seems to me that sound philosophy demands that the questions of evolution and creation should be kept quite distinct the one from the other. The former is obviously a legitimate subject for scientific investigation. If evolution be a fact—and I am not denying that it is—it brings us one step nearer to the origin of things than we were before; but it no more reveals the origin of things than the discovery of universal gravitation solves the problem of the existence and motion of the heavenly bodies. Indeed, it is perhaps incorrect to say that either evolution or gravitation or any of the great discoveries made in physics really brings us nearer to the origin of things: these

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steps in human knowledge rather bring us into successive positions, from which we can obtain profounder views of the mystery in which the origin of the universe is hidden. It is certain that we can appreciate that mystery more completely than our forefathers did: I think there is no good ground for asserting that it is any less really a mystery, or that science has yet done, or in the nature of things can do, anything towards causing the mystery of existence to cease to exist.

Therefore the philosophy of crayfishes, like all other philosophy, when fairly followed out, seems to me to transcend the material universe, to carry the human mind into regions in which physical science does not find itself, to point to the cloud which hides the Creator from our view, and to indicate an almighty hand of mystery behind the cloud which is the maker and the doer of all.

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ESSAY V.

MAN'S PLACE IN NATURE.[1]

WHEN the Royal Agricultural Society held its meeting in Carlisle last summer, I was called upon to preach a sermon at the special service, for which, according to a good custom of some years' continuance, the Society makes arrangements. The congregation consisted chiefly of the herdsmen and others brought together by the great exhibition. A very interesting occasion it was; and it seemed to me that the nature of the congregation, and the thought of the collection of animals, in the midst of which our church-tent was pitched and our worship was conducted, might suggest as the most suitable topic for consideration the difference between man and beast. Accordingly I spoke upon this great subject; and I think now, as I did then, that it was as good a subject as I could have chosen.

But of course it was not possible to do more than

[1] Reprinted by permission from the *Nineteenth Century*. The essay was originally delivered as a lecture, which fact may account in some measure for its style.

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touch the fringe of so vast a question in a sermon, especially in a sermon to such a congregation ; and I have felt a temptation, ever since the meeting of the Royal Agricultural Society, to develop somewhat more carefully and systematically thoughts which were in my mind when I preached to the herdsmen. The consequence has been, that I have determined to put together some thoughts concerning 'Man's Place in Nature'—a grand subject, if not a novel one—a subject which has, however, presented of late years some novel aspects, and is worthy, therefore, of continued consideration.

It is true that there are certain points of view, from which if we regard the subject we may make very short work of it. Man's place in nature (as most of us would be willing to concede) is that of *facile princeps* ; he is the lord and master of all ; he stands unique amongst the creatures of God ; his attributes and his destiny are such as to separate him, not only in degree, but in kind, from all other living beings. Divine and human testimony combine to establish this view ; and it will assist me to introduce those considerations which will form the substance of this essay, if I first refer to the testimony of which I speak, and dwell for a few moments upon it.

The Holy Scriptures are built upon the hypothesis of the supremacy and the unique position of man in creation, as upon a foundation. Indeed, it may be said that every religion which ever has been or ever

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can be established in the world, is based upon this: men may deify and worship bulls, and cats, and crocodiles, as the ancient Egyptians did; but the deifiers and worshippers must have been, and doubtless were, quite sensible of their own superiority to the creatures which they so treated. For my purpose, however, it will be sufficient to observe the remarkable manner in which the only religion in which most of us are likely to feel much interest is expressly and professedly built upon the supremacy of man. The great purpose, almost the only purpose, of the opening chapters of Genesis would seem to be the laying of this foundation. The first chapter of Genesis is not an essay on geology, but an essay on man. 'Let us make man in our image, after our likeness, and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth.' 'So God created man in His own image, in the image of God created He him; male and female created He them.' 'The Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul.' Passages such as these are the foundation-stone of that religion, which alone influences, to any extent, the minds of the most civilised and advanced of the nations of the world.

In truth the hypothesis of the possibility of a revelation, or indeed of a religion of any kind, implies an antecedent hypothesis as to the unique and

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supreme position of man. Without the supposition of man being a creature capable of a revelation from God, it is manifest that the whole conception of the Bible, Old Testament and New alike, evaporates and vanishes. No one, I suppose, would care to argue that even the highest amongst the beasts was susceptible of even the lowest degree of religious feeling.

But something analogous to this may be said with regard to literature not claiming, like the Holy Scriptures, a divine origin. The utterances of poets and philosophers must be taken into account in any system of anthropology; the very existence of poetry and philosophy, like the existence of religion and sacred books, is a fact to be taken into account in estimating man's position. With regard to their utterances, I confess that I would rather trust a poet as an expounder of man, than I would trust a student of natural history. I do not say that either is to be followed blindly without consulting the other; each has his own department, and each is perhaps liable to be led astray, so as to see one profile of the human face, and one only; but if we must have one side of humanity chosen as the principal subject of examination, the spiritual side, which presents itself to the poet or the philosopher, is grander, more human, more worthy of study, than the physical or animal side. I would even venture to say that in a matter of this kind the prophetic insight of the true poet is more powerful as a means of investigating truth than

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the habit of accurate observation of physical phenomena which distinguishes the student of natural history.

Make Shakespeare in this, as in most other things we may, the spokesman for the whole family of poets. Remember Hamlet's words: 'What a piece of work is man! how noble in reason! how infinite in faculties! in form and moving how express and admirable! in action how like an angel! in apprehension how like a God!' Shakespeare knew nothing about the evolution of man from inferior forms, and even if he had I do not think that the knowledge would have interfered with his conclusion; but I venture to assert that such words as those which I have just quoted are more deeply and solemnly true, and throw more light upon man's constitution, than much which has been put forward by physical students.

Let me give one more poetical utterance. It is in a lower key and much less forcible than Shakespeare's, but I think it worthy of production because it exhibits very keenly that complicated constitution of man's nature which so utterly differences him from other creatures, and which makes it so absolutely clear that he must have a class entirely appropriated to himself.

> Chaos of thought and passion, all confused;
> Still by himself abused or disabused;
> Created half to rise and half to fall;
> Great lord of all things, yet a prey to all;

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> Sole judge of truth, in endless error hurled;
> The glory, jest, and riddle of the world.[1]

Not an altogether comfortable description of human nature, and yet one which we cannot disclaim as having no marks of truth; a description which, if it has any truth in it, must prove that a real science of anthropology must transcend physics.

I have connected philosophers with poets as exponents of man's place in nature. It is not that the philosophers, either ancient or modern, have been entirely of one mind on the subject, and that we can consequently point to certain conclusions as having the unanimous verdict of the whole philosophic tribe. On the other hand, the opinions held have been most various, and these opinions have divided philosophers into different schools, both in ancient and in modern times. But the mere possibility of the discussions in which the most thoughtful men have been engaged in all ages, the formation of schools, the earnestness with which arguments have been carried on concerning man's greatest good, the grounds of duty, the nature of his destiny, and the like great human questions, all this seems by itself to prove, or rather to postulate, the unique position of man and the high elevation of that position. Socrates and Plato, Cicero and Seneca, studied man's place in nature with such light as they could find; and Pascal, with a brighter light shining upon the problem, has nevertheless

[1] Pope's *Essay on Man.*

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devoted a large section of his 'Pensées' to the 'Greatness and Misery of Man.'

It is impossible to do more than touch in the most passing manner upon the views held by ancient philosophers; but I should like to quote two short passages, put by Plato into the mouth of Socrates, as indicating the high view which it was possible for a philosopher more than two thousand years ago to take of the moral obligations and the future destiny of man.

The first quotation is from the 'Apology.'

> I thought, says Socrates, that I ought not to do anything common or mean in the hour of danger: nor do I now repent of the manner of my defence, and I would rather die having spoken after my manner, than speak in your manner and live. . . . The difficulty, my friends, is not in avoiding death, but in avoiding unrighteousness; for that runs faster than death.[1]

The other quotation represents some of the last words of Socrates, before taking the poison.

> I would not have [you] sorrow at my hard lot, or say at the burial, Thus we lay out Socrates, or, Thus we follow him to the grave, or bury him; for false words are not only evil in themselves, but they infect the soul with evil. Be of good cheer then, and say that you are burying my body only, and do with that as is usual, and as you think best.[2]

I am disposed to think that language of this kind to which a deeply thinking man has been led by the

[1] Jowett's Translation, vol i. p. 353.
[2] *Phædo*, vol. i. p. 466.

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contemplation of his own being, and by the effort to bring his practical conduct into harmony with that which he believes to be right and true, is more valuable than any words which he may utter when indulging in dry speculation upon human nature. The philosopher is most likely to be a successful student of man when he feels that he is a man himself. Pope tells us that

> The proper study of mankind is man,

which in a certain sense is true ; but it is equally true that the proper student of mankind is man, for man's nature cannot be put under a microscope, or measured by mathematical rules, or submitted to chemical tests ; it is too subtle for any analysis such as these ; it can only be thoroughly examined when a man studies his own conduct and character, and satisfies himself that he is something which no other creature of God is, that he has powers which no other creature has, and that therefore he is somehow different not merely in degree but in kind from all other creatures which the earth contains.

Consciously or unconsciously the question 'What is man ?' has been one of those which have exercised human thought in almost all periods ; and undoubtedly one great help in answering the question is to be sought in the conclusions of the thoughtful and the good : the conclusions of heathen philosophers are not even now to be despised : they have their

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value, nay in a certain sense they are more precious than those reached by men who have had the privilege of Christian teaching, because they show the results to which the human mind comes by its own pure unaided efforts. In fact it is difficult to say, since the atmosphere of human thought has been so thoroughly impregnated with Christian doctrine, how much of current opinion belongs to man and how much to divine revelation: but it is remarkable that the most recent effort to substitute another religion for the old faith of the Church depends upon exalted though fanciful views of the nature of man. In the religion of humanity for the idea of God is substituted that of the human race: the human race is immortal, all-powerful, all-worthy; the thought of advancing and benefiting the race is the one sufficient spring of high and noble action, and the thought of the perpetuity of the race takes the place of the belief of personal life in the world to come. A strange religion, no doubt: one of which it is not difficult to prophesy that it will never be very widely spread, and will never take deep root, but interesting so far as my present subject is concerned, inasmuch as it indicates a deep-lying conviction and a powerful testimony in favour of the dignity of man's place in nature.

But we may leave philosophical speculations and philosophical religions, and come down to the region of the common sense of mankind. This common sense tells us, not merely that 'man is a noble animal,

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splendid in ashes and pompous in the grave,'[1] but that he stands absolutely by himself in creation. His superiority is not of the same kind as that which a dog might claim over a lobster, or an eagle over a beetle, or a fish over a worm. The difference is of a kind which a naturalist simply cannot measure; it depends upon moral characteristics, involves considerations of feelings and affections, deals with conscience and the sense of right, recognises the power of an independent will, cannot limit itself to the life which now is, but stretches out into the future and only attains its complete development on the other side of the tomb. I do not say that some or all of these points of difference may not be contested, and are not contested by some amongst us; but I think I am not wrong in saying that the general sentiment or opinion, or, as I have called it, the *common sense* of mankind, is a testimony, whatever it may be worth, on the side of those who would assign to man an indefinite superiority above other creatures, that kind of superiority which is asserted by the transcendent phrase, 'created in the image of God.'

Hence it might seem to be waste of time, especially in this late period of the world's history, to discuss in any way man's place in creation. But views have been advanced in our own time by scientific men, and coming from them have necessarily considerable weight, which tend very much, and per-

[1] Sir Thomas Browne.

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haps it may be said very painfully, to degrade the view which men in general, to say nothing of poets and philosophers, have been in the habit of holding concerning man. Suppose we are told, for example, that all life comes from a slime which has been spontaneously generated, that from this slime come the simplest forms of living things, and that from these simplest forms are developed more complicated forms, from which are preserved and further developed those which in the struggle for existence prove themselves fittest to survive, and that this process, combined it may be with some subsidiary hypothesis, is sufficient, without any supposition of purpose, any action of a creative will, any master mind, to account for all that exists, including man—does not this kind of anthropogony (in giving which I believe I am literally representing and not caricaturing the views of Ernst Haeckel, as expounded in his 'History of Creation') tend to make us at least rather uncomfortable, as though we were threatened with losing our birthright? I am not denying the truth of some doctrine of evolution, or development; I have no more difficulty in believing on good evidence that the human race was brought to perfection by evolution than I have in believing that a bird was once an egg, or an oak once an acorn; but I find an almost impossibility in believing that there was no *purpose* in this evolution and no *mind* directing it and producing the result. I deem this view of the origin of man to be utterly

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untenable, but I am not going to attempt to deal with it specifically; I only refer to it as giving a reason why I regard man's place in nature as a subject worthy of consideration by thinking persons in this nineteenth century.[1]

Regarding then what has been said hitherto as introductory, I now come to the substance of my essay, and I propose to set out a few thoughts which have occurred to me concerning the specific, or if not all of them specific at least some of the most remarkable, differences between man and the other animals which occupy the surface of our globe. The first difference which I shall notice is that well-known one which depends upon the distinction between instinct and reason. The term instinct is perhaps not easy to define accurately; in the first dictionary upon which I lay my hand I find it described as 'a natural impulse to certain actions which an animal performs without deliberation, without having any end in view, and frequently without knowing what it does.' A not

[1] Supposing the first place in nature assigned to man, as no doubt would be the case whatever judge or jury might be appointed to try the case, it is a curious subject of speculation what creature should have the second place. The monkey might claim it on the ground of corporal resemblance and of some of his habits; the dog might allege that he was man's dearest companion, knew his ways and tastes best, and was most in sympathy with him; the 'half-reasoning elephant' could not be summarily passed over: and with regard to social arrangements and domestic life probably the ant would put in a claim to be heard. I confess that, while the first place can be decided without doubt, the second appears to me to be absolutely incapable of being awarded.

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altogether satisfactory definition, as it assumes something concerning the animal which it would be hard to prove. Here is a more recent definition. 'Instinct is action taken in pursuance of an end, but without conscious perception of what that end is.'[1] This again does not quite satisfy me, as it assumes a want of perception which it might be difficult to demonstrate. Is not instinct rather that which leads to an action having some end, but not dictated by teaching either of any other creature or of experience? It is the doing something intelligent without having been in any way taught to do it which constitutes the peculiarity and the marvel of instinct; and it may be said in general that reason belongs to man, and instinct to other animals; while yet it must not be asserted that the animal has a monopoly of instinct, or the man of reason.

When, however, we come to examine the proportion in which instinct and reason are divided between man and other animals, we shall find that the monopoly, though not complete, is, as far as instinct is concerned, very nearly so. Infants suck by instinct, and when we have said this we have gone a long way towards exhausting the obligations under which human creatures are laid by this part of their nature. I do not say that there are not other actions, even in adults, as, for example, the shutting of the eyes

[1] Von Hartmann, quoted from Butler's *Unconscious Memory*. I have substituted *end* for *purpose*.

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suddenly under the influence of a sudden danger, which may perhaps be properly called instinctive; but when all has been put together which can fairly be attributed to instinct in man, it really amounts to the merest trifle in the conduct of his life. Just compare it, for example, with what takes place in the case of insects. I pass over the familiar cases of bees, wasps, ants, and spiders, and will mention what is done by the stag-beetle. The larva of the stag-beetle has to make for itself a hole in which it can become a chrysalis. The female larva digs a hole of exactly her own size; but the male makes one as long again as himself, because when he becomes a beetle he will have horns as long as his body, which the female will not. But how could he know this?

It would be very easy to fill a volume with wonderful examples of instinct, though it would be difficult to surpass that which I have just given; and it is manifest that any examples of instinct in man, even though the domain of instinct be wider than I have represented it, are absolutely trivial when compared with the almost miraculous doings of instinct in the lower regions of animal life. But when we look at the other attribute which I have coupled with instinct, and which I have called reason, the tables are exactly turned. Here we find in the animal the merest glimmering, and in man something which amounts to almost unlimited power. It was the habit at one time to deny reason to the lower animals altogether; but I

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think that this is going too far ; hundreds of dog stories seem to assert reasoning power for dogs beyond all doubt. I should be disposed to grant it without hesitation to horses, cats, elephants, foxes, in fact to all the higher animals. Can any one deny it to birds, who reads the story of the war between the herons and rooks at Dallam Tower, and of the permanent peace established upon the basis of a division of territory ?[1] In fact, the difficulty seems to me to be that of knowing where reason ends, rather than that of coming to the conclusion that it certainly exists. But after all, to what does the highest effort of reason

[1] This story, which may be found in Bewick's *History of British Birds*, has been lately told more fully in a pamphlet entitled *Observations on the Heron and the Heronry at Dallam Tower, Westmoreland*, by the late Thomas Gough, of Winbarrow (Kendal : 1880).

'There were two groves at Dallam Tower, one of which for many years had been resorted to by a number of herons, which there built and bred ; the other was one of the largest rookeries in the country. The two tribes lived for a long time without any disputes. At length the trees occupied by the herons, consisting of some very fine old oaks, were cut down in the spring of 1775, and the young brood perished by the fall of the timber. The parents immediately selected new habitations ; but as the trees in their old locality were only of late growth, and not sufficiently high to secure the nests from boys, the herons attempted a new settlement in the rookery. They met with an obstinate resistance from the rooks, many of which, as well as some of their antagonists, lost their lives. The herons at last succeeded, built their nests, and brought out their young. But this was only a truce. The war was renewed in the following spring, and the herons were again the conquerors. Since that time peace seems to have been agreed upon between them ; the rooks have relinquished possession of that part of the grove which the herons occupy ; the herons confine themselves to those trees they first seized upon, and the two species live together in as much harmony as they did before the quarrel.'

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amount in the case of any creature except man? A dog can never really advance in the scale; he may be domesticated, but he cannot be civilised; he can wag his tail if he is pleased, but he can never say 'Thank you!' and those herons and rooks at Dallam Tower have been contented with that one great feat of war and diplomacy, and have exhibited no special signs of intelligence since the treaty was signed. In fact, the meaning of reason, when applied to man, is so different from that which the word bears when applied to birds and beasts, that it seems almost a difference in kind. With the beasts it means doing something unlike their ordinary doings, and suggesting the thought of likeness to that which is human; with man it means just that which makes him man; it is his ordinary stock in trade; it is that which guides and governs his daily and hourly life; it is that which finds its natural outcome in language and literature and science and philosophy. Without reason man would not be man. The least gifted man, if he be not an idiot of the lowest type, has something which the most sagacious beast has not; and the most gifted man—what has he? What can measure the mental gifts of a Newton or a Shakespeare?

Nearly connected with the question of instinct and reason is that of inarticulate sound and language. 'The study of words,' says Max Müller, in his introduction to his lectures on the science of language—

may be tedious to the schoolboy as breaking of stones is to the wayside labourer; but to the thoughtful eye of the

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geologist these stones are full of interest;—he sees miracles on the highroad, and reads chronicles in every ditch. Language, too, has marvels of her own, which she unveils to the inquiring glance of the patient student. There are chronicles below her surface, there are sermons in every word. Language has been called sacred ground, because it is the deposit of thought. We cannot tell as yet what language is. It may be a production of nature, a work of human art, or a divine gift. But to whatever sphere it belongs, it would seem to stand unsurpassed—nay, unequalled in it—by anything else. If it be a production of Nature, it is her last and crowning production which she reserved for man alone. If it be a work of human art, it would seem to lift the human artist almost to the level of a divine creator. If it be the gift of God, it is God's greatest gift; for through it God spake to man and man speaks to God in worship, prayer, and meditation.

Accepting this eloquent description of language, it is almost unnecessary to remark upon the light which the possession of language throws upon man's place in nature. We often speak of the 'dumb animals,' and in one sense horses and dogs and cats are dumb; they can make their feelings known to us partly by sound and partly by action; but they have no articulate means of expressing their thoughts to man, and apparently have only an imperfect power of communication with each other. That there is a power of communication few will doubt. I remember upon one occasion walking up Cader Idris, and observing a sheep standing by himself, apparently as sentinel; when he saw me he uttered a sound which

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I can only describe as a whistle, and running off at full speed was joined by his companions at a short distance, who fled likewise. I have seen also a jackdaw in the midst of a congregation of rooks, apparently being tried for some misdemeanour. First Jack made a speech, which was answered by a general cawing of the rooks; this subsiding, Jack again took up his parable, and the rooks in their turn replied in chorus. After a time the business, whatever it was, appeared to be settled satisfactorily; if Jack was on his trial, as he seemed to be, he was honourably acquitted by acclamation, for he went to his home in the towers of Ely Cathedral, and the rooks also went their way.

I mention these familiar instances which occur to me, and I apprehend that every one must have made observations of beasts and birds more or less similar, or at all events read of them; but after all, to what do they amount? It appears to have been proved recently that the vital principle in a vegetable is identical with that in an animal, as perhaps we might have guessed that it was; and yet there is no error in speaking of vegetables as being quite distinct from living creatures; and so it is not necessary to disbelieve in a certain power of confabulation in beasts and birds, in order to be able to assert that in the true sense of the word language is a human possession. It is human as reason is human; language is uttered reason, reason is language in embryo; and it is

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notable that in the finest form of human language that has yet existed, λόγος is both *word* and *reason.*

From language we may naturally pass to the consideration of the ties of love and affection which bind mankind together. It seems to me that the relation in which the sounds uttered by birds and beasts stand to human language is closely analogous to that in which the feelings of animals towards each other stand to the sentiments which bind men and women together, whether in the family, the Church, the State, or any other human society. Nothing can be stronger than the love of offspring which is implanted in animals, from insects up to mammals. The plover will adopt all kinds of tricks in order to conceal the place in which her nest is made ; the whale will fight for her young ; monkeys may be seen in the Zoological Gardens nursing sick baby monkeys on their laps with a gentleness which would do credit to a trained nurse ; dogs and horses have their friends and favourites as well as their enemies ; the sheep upon the Cumberland fells are said to know those which belong to the same *heaf* ; cats appear to give evening parties ; and throughout the whole animal kingdom there is the most curious parallel upon a low level to those feelings and social ties which, in the high level of humanity, constitute the very essence of family and social life. You may say, if you please, that the two things are identical, and that the one

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can be evolved out of the other; but I think we should, at least, try to realise the distance which separates the highest link of the chain of evolution from the lowest. For example, there is a true family life in a bird's nest:—

> Birds in their little nests agree,
> And 'tis a shameful sight
> When children of one family
> Fall out and chide and fight.

I remember as a child being a little annoyed at having robins and sparrows set up as an example of good behaviour; but, in reality, how very transient and superficial is the love which belongs to a bird's nest; in a few weeks these five or six robins or sparrows will care no more for each other than for any other of the robin or sparrow race; whereas 'children of one family' are constantly found joined together by a love which only grows with years, and they part for their posts of duty in the world with the hope of having joyful meetings from time to time, and of meeting in a higher world when their life on earth is finished.

So, likewise, that instinct which leads to the building of the nest is a type of the law of nature which leads men and women to bring up families. But no one will dare to measure the infinite altitude at which human marriage and family life stand above any type or shadow of them that we can find amongst the humbler creatures; the one reminds us of the other

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much as a molehill might remind us of Skiddaw, or a roadside puddle of Derwentwater. A protuberance on the earth's surface, or a depression in the same, would serve as a definition in both cases, and the identity of definition might seem to prove the identity of the things themselves ; but we can never confound a molehill and a mountain, and so we need not confound the family love of a bird with the feelings of the human heart.

Once more, I have spoken of friendship amongst animals ; there are preferences, alliances made between animals thrown together by circumstances, likes and dislikes, actions of kindness, leagues for self-defence and so forth, which may fairly be described as belonging to the same class of feeling as friendship amongst ourselves. But contemplate friendship, in its reality and its fulness, and you feel almost as much ashamed of comparing anything which exists in the animal world to human friendship, as you would of comparing a dog and a man together. Doubtless the dog *is* like the man, and a comic artist or author can easily and very effectively substitute one for the other; but we feel that the substitute *is* comical and nothing more; the moment we deal with the subject seriously the gap between man and dog becomes infinite: and so, when we have amused ourselves with the habits of animals, and have fancied that we see in them the germs of those feelings of love of which the highest natures know

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the most, we should do well to read a few stanzas of *In Memoriam.*

Thy voice is on the rolling air;
I hear thee where the waters run;
Thou standest in the rising sun,
And in the setting thou art fair.

What art thou then? I cannot guess;
But tho' I seem in star and flower
To feel thee some diffusive power,
I do not therefore love thee less.

My love involves the love before;
My love is vaster passion now,
Tho' mixed with God and Nature thou,
I seem to love thee more and more.

Far off thou art, but ever nigh;
I have thee still, and I rejoice;
I prosper, circled with thy voice;
I shall not lose thee, tho' I die.[1]

Passing to a different department of the subject, I am disposed to think that the difference between man and beast finds a valuable illustration in the manner in which *adjectives* are applied respectively to one and the other. There is sometimes a good deal of eloquence in adjectives, though doubtless they are sometimes misapplied. Take, for example, the epithet *honest*:—

An honest man's the noblest work of God.

Whether this line of Pope's expresses the whole truth or not, certainly the epithet *honest* is not applicable to any creature whatever except man. You may see a

[1] *In Memoriam*, CXXX.

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dog steal a piece of meat, and you may flog him to prevent the theft from happening again; or you may see a pair of old rooks sitting by the side of the incipient nest of a young unsuspicious pair just beginning life, and carrying off for their own nest stick after stick which the young folks have brought home with great trouble and industry; or you may be vexed to find that all your care has not been able to keep the mice from your favourite bit of cheese; but no thought of *dishonesty* enters into your estimate of all this felonious conduct; you laugh at it, or you are vexed at it, as the case may be; but the question of honesty and dishonesty, of right and wrong, never presents itself for a moment.

Or, again, we speak of a *noble* man or a *noble* woman. In this case the adjective does not belong to man or woman exclusively; but the partial share which animals have in such an epithet as *noble* only emphasises the manner in which it supremely belongs to man. You may speak of a noble horse, or of the lion as a noble animal; the dog is supposed to have noble qualities which do not belong to a fox or a weasel; and the hawk was held in the days of falconry to have a true nobility; but what does this nobility amount to? You would shoot your noble horse if he broke his leg in hunting; you would beat your dog if he stole your meat; you would kill your lion if you could; and your noble hawk is but a bird of prey at the best. The word *noble*, when so applied, has a

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meaning different in kind from that which belongs to the patriot, the statesman, the soldier, the martyr.

Once more, take that most comprehensive adjective *good.* There is nothing to which the adjective may not be applied if only it deserves it. We have good horses, good dogs, good dinners, good houses, good governments. But there is a supreme and unique character belonging to the word when applied to man. What a comprehensive phrase is that of a *good man*! It implies, I suppose, honour, honesty, gentleness, brotherly kindness, godliness: it does not, of course, imply perfection, but I think, if you were describing the character of some one who had been taken away, and if, after dwelling upon this feature and that, you were to wind up by saying, 'In point of fact he was a *really good man*,' you would have said as much in his favour as you could easily put into words; and you would perceive in what a different region you were moving from that in which you would find yourself when you spoke of a good horse or a good dog, or of any good thing, whether living or dead. This philosophy of adjectives is worth dwelling upon. But I pass on to another point.

Man has sometimes been defined as a cooking animal, and unquestionably he is the only animal that knows how to cook his food. It is not that he is the only animal that is benefited by keeping a cook; horses, dogs, swine, and perhaps most animals are very thankful to avail themselves of man's culinary

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skill: pigs thrive on boiled potatoes, and a horse after a long journey is all the better for a *bran mash.* But no animal hitherto, so far as I know, has made a single step in the direction of cooking its food. Man might also be described as a fire-making animal, for he alone makes a fire either to warm himself or to cook with; but it is not that animals do not appreciate a fire; does not a dog like a snug place on the hearthrug or even inside the fender?—and it is said that the great African apes will come down from their trees and enjoy the warmth of the embers of the fire which the natives have left, though they have not wit enough to kindle one for themselves. Man feels a want and endeavours to meet it; other animals may feel the want, but they are obliged to submit to it unless man helps them.

This statement, however, requires some little modification. Within certain limits the lower animals are much more skilful in supplying their wants than men. Insects, birds, fishes, reptiles, mammals—one really does not know which department of the natural world exhibits the most skill in supplying its wants. Let me instance the case of *trap-door spiders.* I refer to their doings because they are less familiar than those of ants and bees and other creatures which I might mention. The trap-door spider lives in a burrow which he makes in the ground where the grass grows, generally in a sloping bank; he covers the entrance to his burrow with a trap-door, which works upon a

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hinge, and which so nearly resembles the surrounding grass that only a careful observer can detect it. This, however, is not all; if an enemy finds the door and opens it, and enters the spider's castle, he may very easily fancy that there is no one at home, for in the sides of the burrow, which is lined with a soft silky substance, there are other trap-doors communicating with branches of the burrow, and covering these branches so craftily that they may easily be passed by unnoticed. Nay, if the enemy should be clever enough to find his way into one of these branches, he may still find no one at home, the owner of the castle being perhaps in a branch of this branch of the burrow, concealed by another skilful trap-door.

Architecture of this kind shuts the mouth of any one who should say that the inferior members of creation do not know how to adapt means to ends. Nor can it be said that the power of adaptation does not go to some extent beyond the wonders of instinct. The old story of the bees who destroyed an intruding mouse with their stings, and then covered it over with wax because they could not get rid of the body and feared the results of its continuance in the hive, is only one of a number which go to prove that in the lower world of living things there is unquestionably a power of adaptation to unforeseen circumstances, a reasoning out of results and acting accordingly, which cannot possibly be set down to the credit of instinct properly so called. But the important point to be

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observed is this, the infinite superiority of the animal's operations when it does not reason, and the infinite inferiority of its operations to those of man when it does. It has been said that a bird will carry an oyster into the air and let it drop upon a rock, in order to break the shell and get at the treasure within; a simple operation this, and yet we stand well-nigh aghast at the bird's prodigious superiority above all that we had expected, and we doubt whether such a wonderful feat can be positively substantiated.[1]

[1] The expression of doubt here introduced (which, however, was not intended to imply any doubt on my own part, but rather the feeling which is probable in the case of a person hearing of such a feat for the first time) was the cause of the following letter from a gentleman in America :—

Fairhaven, Mass., August 27, 1881.

DEAR SIR,—Please pardon my presumption in addressing you, but I have just been reading your article published in the *Nineteenth Century*, entitled 'Man's Place in Nature.'

In one of your illustrations you allude to the manner in which certain birds open shell-fish by dropping them from a great height on to some hard substance which breaks the shell and releases the meat, but you question whether this statement can be substantiated by the actual fact.

I have always lived in this town, which is situated on the east bank of the Acushnet river, which is about one mile wide, and separates us from the city of New Bedford directly opposite, and which empties into Buzzard's Bay a few miles to the north. In the spring of the year, when the ice in the harbour is breaking up and numerous gulls are flying in search of food, they are attracted to certain holes in the ice near the shore where men fish with rakes for shellfish, such as quahogs, clams, and scallops, some of which are left in the ice among the weed and grass brought up from the bottom. I have repeatedly seen these birds take quahogs up, perhaps, 100 feet, and then drop them on the ice, always breaking them the first time, the gull descending quickly and eating the meat. But what was the most surprising and

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I will not say that there may not be in insects and birds and mammals the germ of that faculty which invented the steam-engine; but certainly it seems almost impossible to contain in one description or definition two faculties so diverse in the importance of their results. Adaptation of means to ends is not in the case of man something subsidiary to instinct, and exhibiting itself now and then in exceptional circumstances, but it is the very law of his being. The merest savage contrives machines to catch his prey; he makes his stone implements till he sees his way to bronze and iron; he constructs his boat, or floats on his log of timber; he may be and doubtless is rude and elementary, but he is the genuine ancestor of James Watt and George Stephenson.

There is a higher department of work, of which men may claim the absolute and undisputed monopoly. I mean the department of art. A love of art, an attempt to do something artistic, to make something which shall have a value independent of mere considerations of utility, seems to be a necessary part of man's nature. The rudest races are fond of orna-

wonderful to me was this fact: on a very windy day the wind would leave the shellfish on the shore, if taken up in a vertical line from where it lay, and therefore, to obviate this, in every instance the birds would fly to windward, with such nice calculation that the object would drop within a few feet of where it was picked up.

I have watched this operation a number of times with a good deal of interest, and thought you would like to know the fact.

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ments, and representations of animal forms have been found upon bones of such antiquity as to carry us back to prehistoric times. I am not aware of the existence of the merest germ of art in the works of the lower animals : they construct things which to a human eye are full of beauty—a honeycomb, a bird's nest, or a cobweb may very well be regarded as beautiful—but these fair works belong to the realm of instinct, and you can no more conclude from a honeycomb that a bee has a sense of the beautiful than you can conclude that it has a taste for mathematics. I do not forget that Mr. Darwin attributes great results to the preference shown in the choice of mates on the ground of beauty, and I do not deny that this may be so ; if it be, it is analogous to what takes place amongst ourselves ; but the sense of human beauty which leads to preference or admiration or enthusiastic devotion of man to woman, or woman to man, belongs to an altogether different department of the mind from that which leads to the study and love of art.

The reference now made to human beauty leads me to speak of some other points connected with personal appearance. It has been remarked that man is the only animal that possesses a chin ; and I believe the remark to be true. Upon any theory of evolution, which does not proceed upon the supposition of a divine purpose working itself out according to certain laws, and having for its distinct end the production of

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the noblest form of organised matter, the chin would be a difficulty. It answers no special purpose, and in the struggle for existence it would seem to give no advantage to the possessor over a creature not possessing such a feature ; and yet there it is, and it forms a very important element in the human countenance ; no disciple of Lavater would be wise in neglecting its existence. I do not know that there is any other feature which can be said to be monopolised by man ; but the human features play so much more important a part than those of any other creature, that they seem to be almost different things. What animal has a nose, except man ? There are snouts, and beaks, and trunks, and organs which can breathe and smell as the human nose can ; but think of the great Duke of Wellington's nose ! It was almost the man himself ; breathing, smelling, snuff-taking, were all forgotten in the presence of that grand feature, which seemed in itself to declare its owner to be capable of the victory of Waterloo.

The lower animals have a greater share in the eye than they have in the nose and chin. You may tell the temper of a horse to a great extent by his eye ; and I have seen a mastiff, when he has been offended, exhibit a savage feeling of resentment by the eye alone which seemed instantaneously to turn him into quite a different dog ; but be as generous as we may in an estimate of the eyes of animals, regarded as features, there is a simply immeasurable distance

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between the eye of a beast and that of a man. What a boundless thing is that which we call *expression*! how varied and complicated it is! how much genius and labour and skill are required on the part of an artist to enable him to represent upon canvas the ever-changing expression of the eye of a man or a woman of high intellectual power!

The portrait of a man is generally the portrait of his face; you may have a full-length portrait sometimes, especially if a lord mayor wishes to exhibit his robes, or a master of foxhounds to show his boots; but these accessories can be put in by inferior hands, the great artist concentrates his efforts upon the face. I may throw in a remark which was made to me by one of the chief portrait-painters of our own day. I told him that I had heard a person remark that when his pictures came to be looked at in future centuries men would say, How handsome our ancestors were! To which the artist replied, 'I assure you honestly that I have never yet succeeded in committing to canvas one half the beauty which I have seen in any face that I have ever painted.' How would the inferior animals fare, if they were treated thus? What would Landseer's dogs or Paul Potter's bull be, if you had merely the countenance? I do not deny that the sketch of a dog's face may be very spirited, but at best it is only a fraction of the animal; you want him from nose to tail, if you are really to enjoy him. If dogs had any voice in the matter themselves, I am

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convinced that they would be unanimously in favour of full-length portraits.

And there is a remark which may be made, but which I have never seen made, with reference to the human face divine, as compared with the visage of the inferior animals, namely this, that the human face alone of all faces is capable of increasing in dignity, and even in beauty, with age. The great number of years which belong to human life is in itself a fact to be taken into account in comparing man with beast; but this is not the point upon which I am now dwelling; I am referring to the fact that old men, and old women too, have sometimes a beauty which is quite distinct from that of youth, and which, so far as I know, has no parallel in the lower levels of life. It may be said that human creatures would be seen to decline in beauty if you saw them as you see animals, and if your observation was not confined to the face, while the poor withered body is enveloped in handsome garments. But this only brings us back to the remark before made, namely, that it is the face, and not the whole carcass, which serves for the portrait of a man. And certainly it strikes me as a point worthy of being dwelt upon, indicating, as it does, the high spiritual level of man's being, that it is possible to see in his face lineaments of exquisite beauty when his physical powers are failing, and his earthly life almost ebbing away. Who cannot call to mind faces, or remember portraits, which fully bear out the observa-

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tion which I have now made? 'The hoary head' may be 'a crown of glory,' artistically as well as morally and spiritually.

But there is a higher view than any that I have yet taken with regard to man's place in nature. The 'main miracle,' as Tennyson puts it, is

> that I am I,
> With power on my own act and on the world.[1]

This power over ourselves, power of resisting inducements presented to the lower parts of our nature, and determining our actions upon grounds of justice, morality, conscience, religion, appears to assert for men a position in the world to which the most gifted of the inferior animals can lay no kind of claim. It may be argued, as it is argued, that man is only the highest of organisms, that there is no difference in kind between him and the lowest ascidian out of which he has been evolved, that the whole question of human conduct is a matter of nerves and brain, and that morality itself is ultimately a form of phosphorus; but I think that this view is only one of those puzzles which are necessarily presented by the complex nature of man. Man is undoubtedly material, but it would be contrary to all our highest belief and experience to say that he was simply and wholly material; the existence of anything besides matter in man may be the 'main miracle' of his existence, but

[1] *De Profundis.*

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it would seem to be a miracle which the most sceptical mind would do well to accept; the sense of honour, the dominion of conscience, the bonds of friendship and pure love, may be taken as belonging to a region into which the introduction of chemical and electrical considerations means nothing else but absolute confusion. Considerations depending upon matter must undoubtedly enter into almost all moral questions; the degree of criminality attaching to an act may depend upon the question whether the criminal was sober when he did it; proclivity towards moral faults, such as intemperance or unchastity, may be, and often is, connected with inherited physical infirmities; the condition of the atmosphere at a given time may have not a little to do with the commission of crime; but all such considerations as these do not touch the fundamental question, whether for man there is not a right and a wrong, and the power of doing what is right because it *is* right, and of abstaining from doing wrong because it *is* wrong.

I have referred in a former part of this paper to Socrates; I will make one other quotation from Plato's Dialogues, which bears forcibly upon the point which I am now discussing, and which is interesting because it shows that precisely the same kind of difficulty which is suggested by some of the modern students of physical science, existed and was discussed by philosophers more than two thousand years ago.

Socrates is speaking of a certain philosopher to

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whose writings he had looked for instruction concerning the human mind, and he expresses himself thus :—

What hopes I had formed, and how grievously was I disappointed! As I proceeded, I found my philosopher altogether forsaking mind, or any other principle of order, but having recourse to air, and ether, and water, and other eccentricities. I might compare him to a person who began by maintaining generally that mind is the cause of the actions of Socrates, but who, when he endeavoured to explain the causes of my several actions in detail, went on to show that I sit here because my body is made up of bones and muscles; and the bones, as he would say, are hard and have ligaments which divide them, and the muscles are elastic, and they cover the bones, which have also a covering or environment of flesh and skin which contains them; and as the bones are lifted at their joints by the contraction or relaxation of the muscles, I am able to bend my limbs, and this is why I am sitting here in a curved posture;—that is what he would say, and he would have a similar explanation of my talking to you, which he would attribute to sound, and air, and hearing, and he would assign ten thousand other causes of the same sort, forgetting to mention the true cause, which is, that the Athenians have thought fit to condemn me, and accordingly I have thought it better and more right to remain here and undergo my sentence; for I am inclined to think that these muscles and bones of mine would have gone off to Megara or Bœotia if they had been guided by their own idea of what was best, and if I had not chosen as the better and nobler part, instead of playing truant and running away, to undergo any punishment which the state inflicts. There is surely a strange confusion of causes and conditions in all this. It may be said, indeed, that without bones and

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muscles and the other parts of the body I cannot execute my purposes. But to say that I do so because of them, and that this is the way in which the mind acts, and not from the choice of the best, is a very careless and idle mode of speaking.[1]

It is admirable to observe how nobly Socrates eschews the notion of being merely a collection of limbs and muscles,—the argument is just the same if we should speak of nerves and tissues and electricity and phosphorus,—how he feels within him the power and determination to do what he considers to be good and right, how clearly he asserts that this power, whatever it be, is more truly Socrates' own self than the limbs and outward person which his companions saw, and which they would have called by the name of Socrates. He felt absolutely certain that he had within him, or rather that he himself was, something different in kind from bone and muscle ; and that in virtue of this real self he could act as he thought right, and could in all circumstances say, I *will* do this, I will *not* do that. It may be well even in these days to remember the old puzzle : Suppose a donkey is placed with his head between two equally tempting bundles of hay, what will he do ? the inducements to eat on either side are by hypothesis exactly equal ; therefore the logical conclusion would seem to be that he will eat neither, and therefore starve with plenty on either side of him. Perhaps

[1] *Phædo*, vol. i. p. 448.

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this might be the logical conclusion in the case of a donkey ; but if a man were so placed, he would show the power of independent will, and would do this or that because he chose to do it, and for no other reason whatever.

I have spoken of the sense of justice and morality, the power of conscience, and the like, as distinctive marks of man's place in nature. It is impossible not to carry this view further, and to speak of the religious sentiment as being characteristically and supremely human. The question of natural religion is one so extensive that it needs to be treated by itself, if at all ; and religion in its widest sense, as including revelation and all the different forms of religious truth which have influenced and do influence mankind, is a subject well nigh infinite. All that I shall consider it necessary to do for the purpose of this essay, is to refer to the almost universal prevalence of the religious sentiment in some form or another. We are told that there are races of savages to whom all conception of God is wanting ; and in like manner we are told that there are races, deficient in those thoughts and feelings which we are disposed to regard as belonging to the very essence of humanity ; but these partial and painful anomalies, if they really exist, can scarcely be regarded as interfering with the main proposition, that man as man has a capacity for conceiving thoughts concerning God which no other creature has. The proposition is almost a truism :

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no one for a moment would dream of attributing the possibility of religious feeling to an animal however high in the scale. But what a magnificent truism it is! It is not even necessary for my present purpose to postulate the truth of God's being: the question is only of the possibility of framing thoughts concerning such a being as God is conceived to be. A poet is not judged by the literal truth of his representations: he may exhibit the grandest powers that he possesses in the region of pure and absolute fiction; and so, putting aside, if one can, for a moment the question of the actual truth of God's existence, the fact that man's mind has been able to rise to the conception of a being omniscient, almighty, 'which was and is and is to come,' the first cause of all created things, and the loving father of all that lives—this fact is sufficient to difference the mind of man by an absolutely impassable gulf from all that can be called mind in the lower levels of the living world.

And having reached this point I feel as if we had attained an eminence upon which we may 'rest and be thankful,' while calmly contemplating mightier heights still, to climb which might take us into an atmosphere more distinctly theological than would befit the character of this essay.

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ESSAY VI.

LAW, PHYSICAL AND MORAL.[1]

IN the interesting volume entitled the 'Reign of Law,' for which we are indebted to the Duke of Argyll, the following passage occurs :[2]—

Words, which should be the servants of Thought, are too often its masters ; and there are very few words which are used more ambiguously, and therefore more injuriously, than the word *Law*. . . . In its primary signification, a *law* is the authoritative expression of human Will enforced by Power. The instincts of mankind finding utterance in their language, have not failed to see that the phenomena of Nature are only really conceivable to us as in like manner the expressions of a Will enforcing itself by Power. But, as in many other cases, the secondary or derivative senses of the word have supplemented the primary signification ; and Law is now habitually used by men who deny the analogy on which that use is founded, and to the truth of which it is an abiding witness. It becomes, therefore, all the more necessary to define the secondary senses with precision. There are at least five different senses in which Law is habitually used, and these must be carefully distinguished :—

[1] Reprinted by permission from the *Contemporary Review*.
[2] Chap. ii.

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First, We have Law as applied simply to an observed Order of facts.

Secondly, To that Order as involving the action of some Force or Forces, of which nothing more may be known.

Thirdly, As applied to individual Forces, the measure of whose operation has been more or less defined or ascertained.

Fourthly, As applied to those combinations of Force which have reference to the fulfilment of Purpose, or the discharge of Function.

Fifthly, As applied to Abstract Conceptions of the mind —not corresponding with any actual phenomena, but deduced therefrom as axioms of thought necessary to our understanding of them. Law, in this sense, is a reduction of the phenomena, not merely to an Order of Facts, but to an Order of Thought.

If it be true that the word Law is used habitually in all these senses, and probably more (as the phrase 'at least' seems to imply),—and I am not intending to dispute this,—it is quite certain that the previous assertion, namely, that the word Law is used ambiguously, and therefore injuriously, must be abundantly true also. But such a loose use of an important word can scarcely fail to suggest that it may be worth while to attempt a closer examination of the idea which the word is intended to convey, and of the manner in which it ought to be used. Such an examination can scarcely fail to be interesting; I believe it may also be useful; and I am bold enough to think that the treatment of the question contained in this paper will be found to be in some measure both interesting and useful to those who care to enter

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upon the discussion of a subject which is essentially one of difficulty.

There is a majestic passage in the commencement of the 'Ecclesiastical Polity,' in which Hooker gives us a definition of Law :—

> All things that are have some operation not violent or casual. Neither doth anything ever begin to exercise the same, without some preconceived end for which it worketh. And the end which it worketh for is not obtained, unless the work be also fit to obtain it by. For unto every end every operation will not serve. That which doth assign unto each thing the kind, that which doth appoint the form and measure, of working, the same we term a law.[1]

I quote this passage because it exhibits the conception which is exactly opposite to that placed in the forefront in the enumeration of the senses in which the word Law is used, given by the Duke of Argyll. The first sense mentioned in this enumeration is 'an observed order of facts;' and probably, so far as physical science is concerned, this is the primary conception to a modern mind. The conception which presented itself as the primary one to the mind of Hooker was not so much the order as that which causes the order—'that which doth appoint the form and measure of working'—it having been already assumed that 'all things that are have some operation not violent or casual,' in other words, an 'order' which may conceivably be 'observed.' The man who observes the order and the man who discovers the

[1] *Ecclesiastical Polity*, Book I. chap. ii. § 1.

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cause of the order may equally claim the discovery of a law, and the two only need a definition of the term used to prevent them from quarrelling over their spoils.

The trouble which existed between Flamsteed and Newton, and the controversy which was raised some years ago concerning the merits of this great scientific quarrel, will illustrate this. Newton wanted Flamsteed's observations in order, as he said, to complete his theory of the moon: Flamsteed said that the theory of the moon was already complete, and grudged the use of his observations. The word *theory*, used ambiguously, and therefore injuriously, was the cause of the trouble. Flamsteed understood by a theory an 'observed order of facts;' and he thought that if the order was so completely known from observation that the future motion of the moon could be predicted, the theory was complete. Newton understood, on the other hand, by the word theory the reference of the moon's motion to the 'cause which appointed the form and measure of its working.' Newton's conception of a theory was new, and Flamsteed was perhaps not to blame for not understanding it; but it is none the less true that the misconception of the term led to serious trouble.

May we not get over the difficulty with regard to the word Law by introducing qualifying words to express the sense in which it is used? It seems to me that if we agree to distinguish between what I will call *objective* and *subjective* law, we shall introduce

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a distinction which will lead to the clearing away of much confusion. The distinction will be analogous to that which is recognised between Plane and Physical Astronomy, or between Geometrical and Physical Optics. In the one case we are concerned with orders of facts, in the other with that which lies beneath such orders. I say advisedly *lies beneath*; and I may add that the subjective laws which lie beneath the objective may be indefinitely numerous, one law depending upon that immediately below it, that upon another still lower down, and so on indefinitely, like geological strata. Moreover the objective law may be the result of several co-operating subjective laws, and each of these may depend upon one or more beneath, and so on. If this view be admitted, we shall be able to take either a descending course from the objective to the subjective, or an ascending course from the latter to the former; either we can descend from the observed order to Hooker's causative and directive law, or we can ascend from this causative and directive law to the observed order.

Let me illustrate what I have now written by reference, not to science, but to an observed order in common life.

Going through a street of a town, I observe that all the houses are of the same height, that they agree very closely in pattern, all have balconies, &c. &c. This is the observed order: it constitutes, so far as the observation goes, a *law*: I should call it an *objec-*

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tive law: the suspicion is raised that this outward uniformity is the result of something internal. I inquire, and I find that the property all belongs to one man, and that he has leased his land upon the condition that the houses shall be built in accordance with a certain prescribed plan and pattern: this is the *subjective* law, to the discovery of which my observation has led me.

It is obvious that, although the observed uniformity in the building and the conditions of building enforced by the proprietor of the land are two things different in kind, yet there is no danger of confusion, if either one or the other be described as the law of the estate. The one is the outcome of the other. The written conditions, according to which the architect works, are potentially the same thing as the effect produced when the architect has done his work.

Notice, in this simple example, the passage from the barest observed fact in objective law to volition or purpose in subjective law. I have gone at once to the conditions prescribed by the owner of the soil; but the analogy with natural phenomena would be more complete if we regarded the observed uniformity of the houses as being dependent, which no doubt in practice it would be, on conditions intermediate. For example, if you inquired why the houses were uniform, the builder might show the contract into which he had entered to build the whole street after one pattern; and that contract might be regarded as the

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subjective law of the street. But you would perceive at once that there must be something underneath that contract, some sub e ctivelaw of the second order upon which the first law rested. The builder might, for example, throw you back upon the architect, and the architect's instructions might be regarded as the subjective law of the second order in question. But you would not rest here, and you would come ultimately to the volition or choice of the person who could say with authority what the order of things or the objective law should be—namely, the owner of the soil.

Thus objective law points to subjective ; the first subjective law to another of the second order ; this, it may be, to a third ; and so on—shall we say, in some cases, *ad infinitum? Why not?*

As observed facts may thus rest upon a series of subjective laws, so there is a class of facts which may be said to rest upon no subjective laws at all, but to be complete in themselves. Let me explain what I mean.

The facts of space and number are a good illustration.

It is a *law* of right-angled triangles that the squares described upon the two sides are together equal in area to that described upon the hypotenuse : it is a *law* of circles that the tangent is at right angles to the diameter : it is a *law* of ellipses that the normal bisects the angle between the focal distances.

So in numbers : it is a *law* that all numbers are

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divisible by 9, the sum of whose digits is so divisible: it is a *law* that the differenee between the square of two numbers is divisible by either their sum or their difference. Hundreds of other theorems, simple and complicated, might be quoted, which may all be regarded as *laws* of numbers.

All laws of space and number, however, are objective laws, and nothing else. You may make one theorem depend upon another, and so reduce the most complex to something which is axiomatic ; but you come ultimately to axiom, not to volition ; to something which must be because it cannot be otherwise, not to something which is because a will has ordained that so it shall be. Whenever you can reduce a law to axiom you get rid of volition ; in space and number, for example, there is no volition ; in physics there are, as I believe, some laws of one kind and some of another.

What is true of space and number is of course true in all departments of pure mathematics. Thus, to take the case of Taylor's theorem. If $f(x)$ be a function of x such that $f(x+h)$ is capable of expansion according to powers of h, then the law of the series is determinable by actual *à priori* demonstration. The formula which represents the series must be, and always has been, true. The objective law stands upon its own foundation. There is no subjective law beneath it upon which it can be said to rest.

It may be well to observe that what is true in the

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case of geometry and numbers and algebraical formulæ is true also of the fundamental propositions of mechanics. The parallelogram of forces, for example, is a law resting (so to speak) on its own foundations ; like the truths of space, it is deducible from appropriate definitions and axioms ; and, like them, it gradually assumes to reflecting minds an axiomatic or self-evident character. It occupies a kind of borderland between geometry and physics ; it is the introduction to the latter, but it belongs to some extent to the former.

When we come to the consideration of physical laws, properly so called, we find ourselves in a new region altogether. Here we have always the objective law as expressed in an observed order of facts, and the subjective law or laws which lie below it.

I will take as the most familiar and most illustrative of these laws what are known as those of Kepler. The Duke of Argyll, in the chapter of the 'Reign of Law,' to which I have already referred, has naturally enough done the same thing, but he has not made exactly the same use of the illustration as that which I propose to make. For my purpose it will be well to quote Kepler's laws, because as regards my discussion of them there is an important difference between one of them and the other two.

The laws are as follows :—

1. The planets move in ellipses, each having one of its foci in the sun's centre.

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2. The areas swept out by each planet about the sun are, in the same orbit, proportional to the time of describing them.

3. The squares of the periodic times of the planets about the sun are proportional to the cubes of the mean distances.

It is unnecessary to explain here that these remarkable laws are not accurately true, but are laws which *would* be accurately true of a single planet regarded as a particle moving round the sun regarded as fixed. It is, however, much to my purpose to observe that to Kepler they were the result of the purest and most laborious observation and calculation ; no chapter in the history of physical discovery is more interesting than that which records Kepler's honest and earnest struggles. He felt absolutely sure that there must be laws of some kind regulating planetary motion ; he made a guess as to what they might be, and having made his guess he proceeded to test its truth : hypothesis after hypothesis was thrown aside as worthless because it failed to conform itself to hard fact, and the result was that the three laws above quoted, and which his boundless ingenuity suggested, stood the test and became part of our recognised knowledge. Great fruits have, as we know, resulted from them, but to Kepler they were complete in themselves ; they were the laws which governed planetary motion, and he was content to have discovered them ; what is curious is that he discovered, as he thought, other

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planetary laws, which were in fact as dear to him as those which remain as imperishable monuments of his genius, if not dearer, and which nevertheless subsequent investigation has proved not to be true.

To use the nomenclature which I have adopted in this paper, Kepler's laws were to him simply objective, and, so far as he was concerned, might have remained so. It was in the hands of Newton that they ceased to be objective, and that the subjective laws beneath them revealed themselves. Coleridge has somewhere said, that, in his opinion, it would take many Newtons to make one Kepler; but this is, I think, quite the reverse of the truth. The genius of the two men was different, but it may be said that it is conceivable that Newton could, and perhaps would, have done what Kepler did, had he not found it done ready to his hands: he had the ingenuity, the imagination, the honesty, the industry, necessary for the purpose; but that Kepler should have done what Newton did is altogether inconceivable; he did not perceive what it was that had to be done; he never (so far as I know) proposed to himself the problem which Newton proposed and solved: he was satisfied with discovering facts, he did not discover nor even search for the laws which lay beneath them.

Let us look at Kepler's laws with reference to the subjective laws of which they are the objective outcome.

All three involve the condition of a central force. But the second law differs from the first and third in

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this respect—namely, that it involves this condition and nothing more; the law according to which the force acts is altogether indifferent; it may be even discontinuous, or may act by jerks, and may be either attractive or repulsive, or sometimes one and sometimes the other. Kepler's law will still hold; nothing is required in order to ensure it beside the simple condition of centrality.

The case is different with regard to laws (1) and (3). They involve a central force, but a central force of a particular kind; it must be attractive, not repulsive, and its intensity must vary inversely as the square of the distance of the planet from the sun's centre. Here we have an example of an objective law depending upon more than one subjective law. On the whole, Kepler's three laws are the expression of an 'observed order of facts,' which is the outcome of three other laws which are beneath Kepler's, and which may be thus enunciated:—

1. The sun acts upon the planets by a force having for its direction the line joining each planet with the sun's centre.

2. This force is attractive.

3. The intensity of the force varies inversely as the square of the distance.

A further generalisation has been made as the result of extended observation and calculation—namely, that an attractive force of the kind detected between the sun and planets is inherent in every part

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of the material universe: the attraction is not *solar* gravitation, but *universal* gravitation: the law appears to belong to matter as matter in every form and under all conditions.

Here, then, we have arrived at a law far removed from Kepler's 'observed order of facts,' and yet supplementing and explaining that order. The question arises, Can we push our law further still? What is the meaning of these laws being laws inherent in matter? Do the laws express something which, like the laws of space and number, could not have been otherwise? Do they carry us as far as to the expression of a supreme will?

I think that in the present state of our knowledge it would be rash to answer such questions as these confidently. The inverse square of the distance has a wonderfully geometrical complexion; it turns up so frequently both in physics and in geometry, that I should not be at all surprised to find it ultimately proved that no other law was possible, and that if two particles of matter attract each other at all, it must be according to this law. Nor should I be disposed to regard the assertion, that the action of force between two particles must be in the direction of the line joining them, as otherwise than probable. With regard to the question of attraction as distinguished from repulsion, I can easily believe that the action of material particles might be either the one or the other: we have, in fact, both attractive and repulsive

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forces in Nature. But suppose that future investigation clears up some of these points, and so pushes our knowledge beyond the limit at which it stands at present, we shall still have the question of the force itself; the laws according to which it acts may be proved to be necessary laws, that is to say, if there was to be force at all it is conceivable that it must be such a force as that which exists. But need force exist? Does the existence of matter imply the action of force amongst its particles? If so, we have pushed back force to the existence of matter; but is that existence necessary? If so, it must be necessary in consequence of the existence of some other law, the nature of which it puzzles the mind even to imagine.

The result of this discussion, and probably of all similar discussions, is to point to a supreme will as the mainspring of all. How many steps it may take to reach that will, and how far the outcome of that will in the form of natural phenomena is conditioned by laws of space and number and the like, it may be difficult to say or even to guess; but it seems to me that the human mind imperatively demands the existence of such a will as the original source of the laws which become objects of observation and knowledge in the material world.

For in truth, in the discussion of observed physical facts, and in the conclusions drawn concerning them, it is rather the *modus operandi* than the *causa operans* with the consideration of which we are engaged. In

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some few cases—as, for example, that of planetary movement—the physical facts, fortunately for human knowledge, assume an orderly form, and then Keplers deduce laws, beneath which Newtons discover other laws; then the deductive process is adopted, and the consequences of the laws are traced out; this leads to further discovery, and so sound knowledge grows. But it may be permitted to speculate that not only in many cases in which objective laws are manifest, as in the laws of atomic combination or of crystallisation, subjective laws at present undiscovered will present themselves, but that in cases in which at present no order is discoverable, order may ultimately be found and law be proved to be dominant. The character of successive seasons, for example, with respect to wet or dry, warm or cold, may turn out eventually to have more regularity than has been at present perceived; and other phenomena which now seem lawless may possibly be found to have a law of their own, though something different from all that we have known hitherto. Nay, it may be that an observed order of facts may be apparently lawless, and yet the subjective law of those facts may be capable of very simple enunciation.

I will illustrate this by reference to an order of facts with which every one is familiar, and which, in consequence of depending upon a human law and not one of Nature, is capable of being discussed from beginning to end.

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Suppose a person to set himself by observation to determine the law of Easter: I fear that he would make but a sorry business of it. Beyond noting that there was always a full moon not very long before it, I suspect he would be unable to detect any law which governed the occurrence of Easter-day. Nor would he be much helped by having the observed order of facts laid down for him for a number of years. This he can find in the beginning of the Book of Common Prayer; but he will deduce very little except confusion from the table there given, which I here insert:—

1854 April 16	1864 March 27	1874 April 5
1855 „ 8	1865 April 16	1875 March 28
1856 March 23	1866 „ 1	1876 April 16
1857 April 12	1867 „ 21	1877 „ 1
1858 „ 4	1868 „ 12	1878 „ 21
1859 „ 24	1869 March 28	1879 „ 13
1860 „ 8	1870 April 17	1880 March 28
1861 March 31	1871 „ 9	1881 April 17
1862 April 20	1872 March 31	1882 „ 9
1863 „ 5	1873 April 13	1883 March 25
		1884 April 13

I should be very much surprised if the most ingenious person that can be found, a man like Kepler himself, could detect any order in this series of facts; and yet it is a most important series, upon which all kinds of events depend all the world over.

But perhaps our Kepler may be assisted by a graphic representation of the series of facts. Law and order are more easily detected in this way than in any other; accordingly, I have reduced the table of Easter to a chart. Here it is:—

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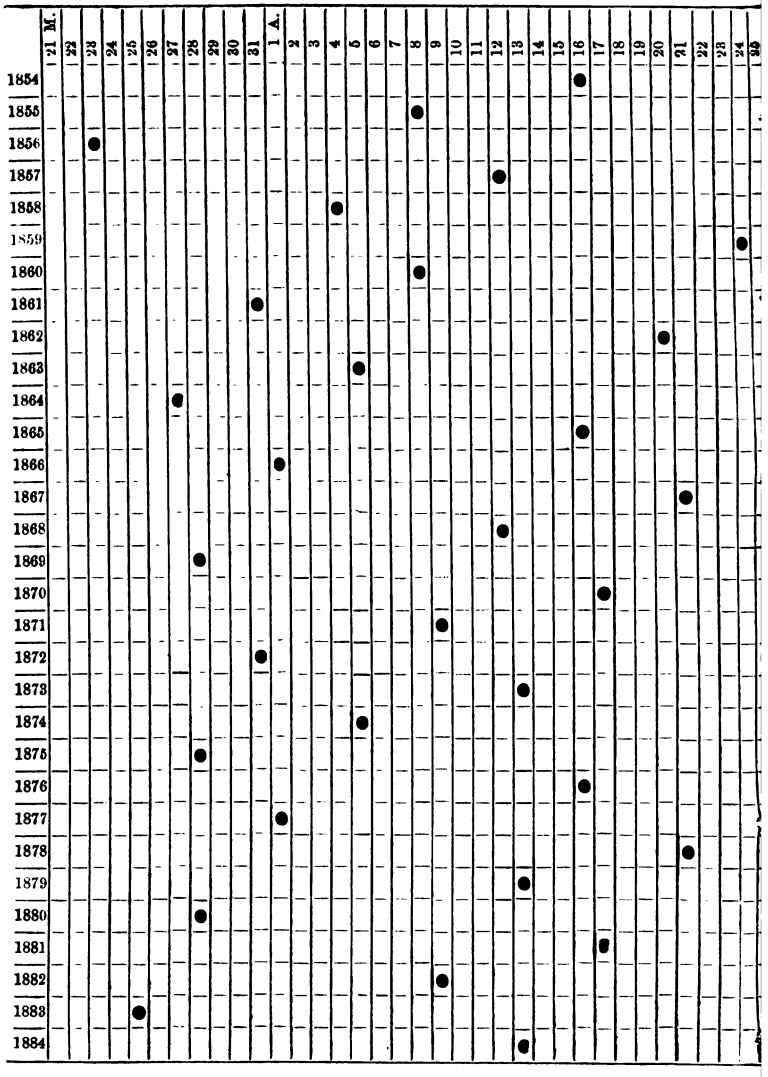

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What does the reader think of it? To me, I confess that the appearance is very curious and interesting, because there is at first sight so much semblance of order in it, which turns out to be no real order at all. The reader will observe the tendency which the dots denoting Easter-day have to run in straight lines, or nearly so: and moreover the tendency of the dots to occur along those straight lines at equal distances from each other, or nearly so. And yet these two laws, which must strike every observer, are, as I believe, absolutely fallacious and misleading so far as the facts recorded by the table are concerned. They do not in the least help us to prolong the table. It would be safe to wager almost any odds, that after complete study of the table an observer would be unable to predict Easter-day even approximately for the year 1885.[1]

[1] I print this sentence as originally published; but it is expressed too strongly, and it called forth the following communication from a correspondent at Nottingham :—

'I venture to submit that the dates given from 1854 to 1884 allow of one rough law being empirically laid down, viz.:

'Rule. If Easter in a certain year falls n days after March 21, then three years later Easter will fall $n-4$ days after March 21.

'Examples:

Easter falls in	1871	on April	9
,,	,,	1874	,,	5
,,	,,	1877	,,	1
,,	,,	1878	,,	21
,,	,,	1881	,,	17
,,	,,	1884	,,	13

According to this rule, then, it might be predicted that in 1885 Easter would fall four days earlier than it did in 1882 (April 9), *i.e.* April 5,

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And yet the subjective law of Easter admits of the simplest enunciation. 'Easter-day is always the first Sunday after the Full Moon which happens upon, or next after, the twenty-first day of March; and if the Full Moon happens upon a Sunday, Easter-day is the Sunday after.'

What can be more simple? It is true that the rule is not quite so simple as it looks, because what is called the Full Moon is not the astronomical full moon, but an imaginary full moon agreeing more or less accurately with the real one, and which is determined by certain artificial rules laid down by ecclesiastical authority; still, understanding the terms of the rule, it is safe to say that the law of Easter, as enunciated in words, is very simple, whereas the order of facts as flowing from that law is as complicated and as devoid of apparent regularity as anything can well be.

which not merely approximates to but is the correct date of Easter in 1885.

'There seem to be two cases of exception to the rule: (1) When the dates approach March 21, *e.g.* in 1886, Easter does not fall on $25-4=21$st of March, but on April 25. (2) After about three instances of regularity the rule is broken by Easter falling on the $(n-3)$rd day; *e.g.* in 1887 Easter falls on April 10, not on April 9.

'I presume that, given time and a far larger number of dates to collate and draw inferences from, it would not be difficult to account both for the law and its exceptions.'

I have thus done justice to my ingenious correspondent, and confessed my own overstatement. But it will be seen that the general truth of the assertion that the table cannot be prolonged with certainty is not destroyed. A rule which answers two or three times and then fails is virtually no rule at all.

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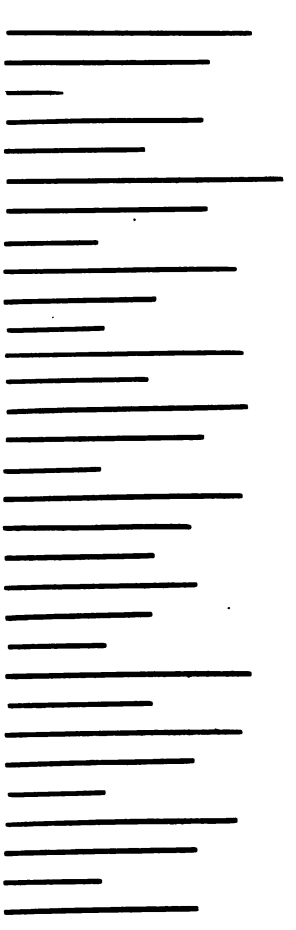
Let me give here a graphic representation of another order of facts, connected with the occurrence of Easter, and to be found in the same table of the Prayer-book, which will be useful presently. The number of Sundays after the Feast of the Epiphany varies as Easter falls earlier or later, and the number for each year is given in the Easter table for a series of successive years. Regarding the length of the Epiphany season as proportional to the number of Sundays occurring in it, I obtain the annexed representation of the lengths of the Epiphany season for the years from 1854 to 1884.



The reader is not likely to detect more regularity in this diagram than in the for-

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mer. He would be puzzled, as in the case of Easter, to prognosticate the length of the Epiphany season for 1885. Nevertheless, he will be bound to admit that the apparently anomalous results which the diagram presents are not anomalous at all, but in reality rest upon a law capable of the simplest enunciation. This being so, let me make use of my diagrams as follows.

Let us suppose, and it is a very reasonable supposition, that the diagram last given, instead of representing the length of the Epiphany season for successive years, represents some physical fact observed with respect to those years; for example, the mean temperature for the year at a certain place, or the number of hours of sunshine, or the duration of easterly winds, or the rainfall, or any other solar or meteorological or electrical phenomenon, which appears to be utterly without law or order. The record of such phenomenon could not be more apparently lawless than the record of the Epiphany season, as given in the diagram; yet in this latter case we know that there is no lawlessness at all, but that the diagram, though apparently irregular, is in reality the interpretation of a law which can be simply enunciated, and that it can be, and actually will be, extended so as to regulate the length of the season in all future years to come. It would seem, then, reasonable to conclude, that the most irregular of physical phenomena may be the result of a simple law, or at least of a law simple in

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enunciation, and accurate in its working, though, like the law of Easter, it may depend upon a variety of elements, which have all to be taken into account before the final result can be obtained.

Will the reader look back for a moment to the Easter-day diagram? Between 1855 and 1857 he will perceive an immense fall for 1856; there is no fall nearly so great till we come to 1883. Yet that fall for 1856 is just as much the result of the general law as the rise for 1859, which, it will be observed, is much higher than any other in the table. May not a severe winter between two mild ones, or the reverse, be the result in like manner of some simple law, certainly difficult to discover, possibly incapable of reduction to a verbal formula? What can be more apparently anomalous than the late mild winter (1881–2), following several of extreme severity? But if severity of winter were measured by the length of the lines in our Epiphany diagram, it would not be more anomalous than the very short line for 1856, following the long ones of 1854 and 1855.

The reader will, I trust, give me credit for not wishing to lay upon the illustration with which we have been engaged more weight than it will fairly bear; but it does seem to me to be valuable as bringing clearly home to our minds such points as these:—

1. It shows how complicated an order of facts may flow from an apparently simple law.

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2. It gives us a good example of the manner in which an order of facts may be connected with a formal law, which formal law is ultimately the expression of a lawgiving will.

3. It warns us of the difficulty which there may be in detecting the subjective law, which underlies an order of facts of a complicated kind.

4. It indicates that, supposing the laws of Nature to be the outcome of an infinite mind and will, they may in reality be conceived by that mind in what may be described as a simple form, although when exhibited in an order of natural phenomena they may be extremely complicated and apparently irregular.

5. We may also find an exemplification of the fact that a law may be laid down by an original volition, that subsequently a change may be made by another act of volition, and yet that there need be no break of continuity in the working of the law. Let me explain. If any one were asked how, when, and by whom the law of Easter was established, he would probably refer to the Decrees of the Council of Nicæa.[1] The law really goes back to still higher Christian antiquity. But since the law was made the Calendar has been reformed, and the change made by Pope Gregory XIII. is now as much a part of the law of Easter as the fundamental law recognised by the Council of Nicæa. The present rule of leap year

[1] On this subject I may refer to the late Bishop Butcher's elaborate work on the *Ecclesiastical Calendar: its Theory and Construction.*

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(according to which 1900, for example, will *not* be a leap year) is a subordinate law introduced by volition, and yet it makes no jar or discontinuity. I cannot, of course, quote anything parallel to this in Nature; but it may seem a not unreasonable conclusion, that it would be rash to assert the absolute uniformity of natural laws from eternity to eternity. Supposing those laws to be dependent upon volition, it would seem to be suggested by what has just been said, that a new law might possibly be introduced also by an act of volition, and yet no discontinuity or catastrophe developed by the introduction of this new law.

This enumeration of points illustrated by the law of Easter, and the order of facts into which that law develops itself, may suffice, though I do not regard it as exhaustive. I will now endeavour to express the thought which I have been expounding concerning law, in a form which may, perhaps, in the case of some readers, give additional clearness to what I have written.

The reader will remember that I have spoken of subjective law underlying objective law, and of the possibility of subjective laws underlying each other in strata, through which if we penetrate we come ultimately to volition. It will give clearness to this conception if we denote these successive strata of law by a series such as the following:—

$$L^0, L^1, L^2, L^3, \quad . \quad . \quad . \quad . \quad L^\infty.$$

In this series L^0 represents an observed order of facts,

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and nothing more. L^1 represents a subjective law, upon which L^0 depends. L^2 is a law which underlies L^1, and so on. Following this series, we may conceive of it as tending ultimately to L^∞, which would represent the volition of an infinite mind.

Take an example from a clock. L^0 will represent the fact that the hands revolve with certain angular velocities; L^1 may refer to the machinery of wheels within the clock; L^2 the descent of a weight; L^3 the action of gravity upon that weight. Here our series ends, so far as observation or proof is concerned; but we seem to see L^∞ across the abyss—something which we can only describe as law resting on volition.

I apprehend that if we could really arrive at L^∞ by continuous reasoning just as we get from L^0 to L^1, from L^1 to L^2, and so on, we should find that L^∞ represented not only the original will by which the law was imposed, but also the means by which that will is made effective. A tendency may be observed in some modern writers to confuse law and cause, to suppose that the whole mystery of the being and action of a thing is explained, if we can only discover and define the law according to which the thing in question is and acts. Whereas, in reality, the ultimate mystery of being and action remains precisely what it was before the law was discovered. The doctrine of universal gravitation teaches us the law according to which each particle of the material universe attracts every other particle; but we have not (at present at

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least) obtained so much as a glimpse of the cause which makes the particles seek each other. The laws of magnetism are pretty well known, and much progress has been made with reference to terrestrial magnetism, but the cause of magnetic action is absolutely unknown. The cause of electricity is in the same obscurity as it was when it was first noticed that amber was made attractive by friction. And though it is known that the circulation of the blood conveys nutriment to all the different constituent parts of a living body, yet the reason why the blood forms skin here, nail there, muscle in another place, and so on, may be said, I suppose, to be simply and absolutely unknown. L° is discovered in a marvellous number of cases; L^{1}, L^{2}, or even L^{3}, may have been investigated, but in no case have we got to the end of the series. Some seem to think the conclusion to be drawn is, that the furthest term to which we can get is the really last; but the really last must be something different in kind from all the others; there is no vital energy in mere law; law may tell us how a thing is done, it does not in the least reveal the original power which does it.

I must ask the reader now to recur to the enumeration of the senses of the word Law, quoted at the commencement of this paper from the Duke of Argyll, in order that he may see the connection between that enumeration and the discussion of law which has been here presented to him.

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The simplest method of seeing this connection will, I think, be found in a reference to the examples which the noble author has given of the several heads of his enumeration.

1. Kepler's Laws—an observed 'Order of Facts.'

2. The conception of Force, of which the 'Order of Facts is the index and the result.'

3. The Force of Gravitation, to which Kepler's Laws are referred, and in which they 'have been merged and lost.'

4. A number of Forces in the condition of mutual adjustment, as in Animal Mechanics—the principle being 'Combination for the accomplishment of Purpose.'

5. 'Some purely abstract idea, which carries up to a higher point our conception of what the phenomena are, and what they do.' 'A good example of Law in this sense is to be found in the Law which, in the science of Mechanics, is called the First Law of Motion.'

I venture to suggest that this enumeration is scarcely satisfactory. The First Law of Motion appears as a law in the most abstract sense, because there is no such thing as the phenomenon of a body moving uniformly in a straight line, that is, under the action of no Force. But neither is there any such thing as the phenomenon of a body moving in an ellipse, as asserted of the planets in Kepler's First Law. Every one of Kepler's Laws is, in a certain sense, imaginary.

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That which is absolutely true is, that *if* a particle move under the action of a force whose intensity varies inversely as the square of the distance about a fixed centre, it will describe a conic section. Kepler's second law will be true of this orbit; and if the orbit be an ellipse, then his third law will be true also. But the sun is *not* fixed, nor do the planets move under the action of the sun only, neither are the planets particles: consequently, Kepler's Laws resolve themselves into ideal conceptions to which the observed order of facts more or less correspond. When Kepler's Laws are said to be 'merged and lost' in the Law of Gravitation, it must be remembered that this only takes place upon the hypothesis of the First Law of Motion being true; consequently, the enumeration which makes the First Law of Motion to follow the merging of Kepler's Laws in that of gravitation seems to me to be defective and misleading. The fact is, that of everything with which a mathematician is concerned, it may be asserted 'that it is an abstract idea . . . which no man has ever, or can ever, see exemplified.' There is no such thing as a straight line, or a circle, or an ellipse; no such thing as uniform rectilinear motion; no such thing as a rigid body; no such thing as a perfect fluid. The mathematician's stock-in-trade is wholly ideal, and the nearer the gross phenomena of the universe and the orders of facts correspond to the mathematician's idea, so much the better both for him and for them.

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It appears to me, therefore, that the last article in the Duke of Argyll's enumeration should be omitted, or should not occupy the place assigned to it. I should further suggest that there is no logical distinction between one force, as that of gravitation in (3), and a number of forces in the condition of mutual adjustment, as in (4) : the fundamental distinction between (3) and (4) is the introduction of *purpose* in the latter. In truth, we cannot say that Kepler's Laws are 'merged and lost' in gravitation only: the force of gravitation would not make the planets move as they do: their motion takes place under the influence of certain originally impressed conditions with regard to direction and velocity, into the nature of which it is unnecessary to inquire, combined with the permanent action of the force of gravitation. Consequently, purpose may be predicated in the case of the planets as truly as in that of the structure of an animal or a plant. The Duke of Argyll would not deny this ; but his enumeration seems to me a little confusing ; the observations which I have made bring the enumeration more distinctly into consistency with the Duke's own remark upon it— namely, that 'these great leading significations of the word Law all circle round the three great questions which Science asks of Nature—the What, the How, and the Why.'

Having arrived at this point, I leave for the present the discussion of physical law. I do so, because I wish to add some remarks concerning moral law in

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connection with that which I have written concerning physical. It seems to me to add to the clearness and breadth of the conception of law, if we regard in their connection with each other these noble twins. The passage which I quoted from Hooker at the opening of this essay might well be taken as containing a definition of physical law. 'All things that are have some operation not violent or casual.' The phrase 'all things' will comprehend the material universe. 'That which doth assign unto each thing the kind, that which doth appoint the form and measure of working, the same we term a Law.' Every word in this definition will admit of a physical application; and yet Hooker was not going to deal with things physical, but with things ecclesiastical, things moral. But the grand conception of law as an all-pervading influence, governing angels in heaven, directing the material universe, and intended to guide men in all their earthly relations, was the very ground-thought of Hooker's philosophical mind; and therefore he instinctively gave a definition of law which would be applicable both to physics and to morals, and which would in a certain sense bind these two together. It seems to me to be very desirable that we should note the wide nature of the true definition of law, and observe what it is that distinguishes its application to physics from its application to morals.

Speaking generally, it may be said that in both physical and moral law, when exhibited in action, we

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have (as in the series given on page 171) an order of facts at one end of the series, and a will at the other. But there are differences between the two cases.

In the case of physics, the order of facts necessarily follows from the presumed expression of will through a longer or shorter chain of causation; and if the order of facts can be observed, it is frequently, though not always, possible to discover one or more links in the chain. But in the case of morals, an order of facts does not necessarily follow from the expression of will in such manner as to enable us to observe the order, and make progress towards discovering the laws and the original volition. In fact, in the case of physics consequences follow laws; in the case of morals they *ought* to follow them, but do not always, because of the interference of other volitions which give rise to inferior disturbing laws. Allowing for these disturbances, it will be seen that there may be the same chain of facts and laws in morals as in physics.

To take an example:—

This country comes to the conclusion that every child shall be educated.

The result is the passing of an Education Act, like that of 1870.

The next result is the formation of School Boards.

These Boards build schools, appoint masters, and take other necessary steps.

The children are required to attend the schools.

Nevertheless, it would be very difficult for any one

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by mere observation of phenomena to infer the Education Act from the order of facts which the streets of a town present. Give me the Act, the original Law, and I can tell you what should be the subordinate chain of laws, and what the ultimate order of facts; but it is almost impossible to pursue the reverse order—namely, to go from facts to laws, as we do in physics.

Indeed, in the case of morals the purpose of a law is that it should be something which, by the very fact of being known, shall produce its consequences. The human will, which by hypothesis is an independent element in the problem, is to be acted upon, and if possible swayed or subdued, by the influence of the law, made known to the possessor of the will. Consequently the will, the purpose, the law or laws, are in morals the known quantities—it is the resulting order of facts which is unknown and doubtful; there is a necessary hiatus between L^1 and L°. On the other hand, in physics there is in many cases no doubt about the order of facts, and frequently we can move some appreciable distance along the chain of causation; it is the ultimate will or purpose that is obscure, and scientifically undiscoverable. Nevertheless, it would seem to be the reverse of unphilosophical to conclude that the basis of physical and of moral law is the same, and to resolve both the one and the other into the ultimate conception of an eternal and all-powerful will.

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It may be a suitable termination to this paper, in which so much has been said of Hooker's definition of law, to refer to the thrice-told tale of his death-bed meditation. The subject of that meditation was the perfect obedience of angelic existences to law. In these supernatural beings, according to Hooker's conception of them, there were joined the complete obedience which necessarily holds in the physical world, and the potentiality of disobedience which belongs to rational creatures ; in them, therefore, was to be found the perfect realisation of what the working of law ought to be : law, the expression of the supreme will, followed by a complete voluntary submission to that will as absolutely right and good. It was in the contemplation of this scene, to which his own studies and writings gave peculiar brightness, that Hooker departed this life. The living philosopher may find material for speculation and thought in that which comforted the soul of a dying saint.

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ESSAY VII.

THE ANALOGIES AND CONTRASTS BETWEEN HUMAN AND DIVINE SCIENCE.[1]

ACCORDING to the programme of this Annual Meeting, the address of the President occupies the middle place between the easy social arrangements of the luncheon-table and the more serious occupation of papers and discussions which are to come hereafter. I feel that your President, in like manner, himself occupies somewhat of a middle place: by his position as the nominal head of your Association he is pledged to take interest in the progress of science and the well-being of literature; while at the same time he cannot divest himself of that character which pledges him above all things to an interest in things divine, and which makes it a necessary condition of his concerning himself with the former that the latter shall not be disparaged or forgotten.

But, indeed, every thoughtful person must, to a

[1] This Essay was delivered as an address to the 'Cumberland Association for the Advancement of Literature and Science.'

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considerable extent, occupy mentally and spiritually something of this middle place: every human soul, which is conscious of the dignity of its own being, touches the things temporal with one hand, and reaches out towards the things eternal with the other; and while it is foolish and fanatical to interest ourselves only in those thoughts which connect themselves with what is knowable through the processes of the human intellect, it is unphilosophical, to say nothing more, to concentrate our minds absolutely and exclusively upon this department of knowledge, so as practically to deny the existence of another department of equal importance, and possibly of deeper and more abiding interest. Hence it has occurred to me that I might, perhaps, occupy your time for a few minutes advantageously, and deliver what might, under your kind indulgence, be regarded as an address suitable to this occasion, if I discoursed to you on what may be called the 'Analogies and Contrasts between Human and Divine Science.' I do not wish, however, to be tied up too closely to this title; I invite you rather to join me on a mental afternoon's excursion, with the phrase, the 'Analogies and Contrasts of Human and Divine Science,' as the general chart for our walk, and as a guide to bring us safely home if we should chance to wander or to lose ourselves.

I commence with a sincere apology for my apparent audacity in presuming to speak on the subject of

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Science; but a person, who years ago was more or less conversant with the elements of some few branches, may be able at least to take account of the progress which science has made and is making, even though he be altogether unable to keep pace with it: just as an old post by the side of a stream may give us some notion of the rate at which the stream is running, though it remains hard and fast in its position. I think I have on some former occasion, though I forget when, quoted an amusing observation of the late Professor Sedgwick, who congratulated the Cambridge Philosophical Society on the evidence of mathematical progress, which was to be found in the fact that he himself had not been able to understand any memoir that had been read before it for some twenty years. So I also in my humbler way can mark the progress of science, while unable to follow it. I cannot quite say, *Non equidem invideo: miror magis.* Certainly *miror*: perhaps to a certain extent *invideo.* The pleasure of investigation by means of those powerful helps which mathematical science supplies, or even of reading and understanding what has been done by others, is such as perhaps only mathematicians can duly, or even approximately, appreciate. Such pleasure can never again be mine; yet it is a pleasure of memory to have once known that of which I speak.

In this condition of scientific helplessness, it is a great satisfaction to be able to turn to such a book as Professor Tait's 'Lectures on some Recent Advances

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in Physical Science.' I shall make free use of this volume, partly because it supplies in a very convenient form the kind of material which I require for the purpose of some portion of this address, partly because the author is a genuine scientific man, and one who does not confound real advance in science with mere speculation or rash unwarranted generalisation. I have the less hesitation in using Professor's Tait's book, because many years ago I examined him for his degree, and I remember that early in the examination his remarkable powers caught my attention, and I was confident that we had got the right man in the right place when we placed him as Senior Wrangler. In these circumstances, you will, I am sure, admit that any theft on my part from the Professor's Lectures may be described as justifiable appropriation.

I wish, then, to direct your attention to two or three great advances which have been lately made in our scientific knowledge—advances which have a special interest, as bearing upon the general question of the structure of the physical universe.

Towards the knowledge of this structure we have been making steady progress for many years. The establishment of the Copernican theory was one great step: the discovery of Kepler's laws of planetary motion was another: the theory of universal gravitation applied by Newton to explain the mechanical motion of the heavenly bodies, and the more complete development of the results of the theory by

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Laplace, Lagrange, and other masters in mathematical science, have been a still further and a quite gigantic step. These and the like theoretical investigations, combined with almost unmeasured improvements in methods of observation, have advanced physical astronomy to an exceedingly high scientific pre-eminence, and one from which it may be safely asserted that it can never again be dislodged. Then, on the other hand, such discoveries as that by Dalton of the combination of the atoms of matter according to definite numerical proportions, and the investigations made through the microscope of small objects close at hand, corresponding to the investigations made through the telescope of distant bodies, have established another branch of physical science upon foundations hardly less secure than those upon which physical astronomy itself rests. Had our knowledge of the material universe been found incapable of advancement beyond the point which it had reached, say, forty years ago, the results would still have been splendid, and absolutely marvellous to contemplate.

But it is the almost necessary result of scientific discoveries to lead on to others, and also to give unity and simplicity and consistency to the knowledge already attained: and I wish to call your attention to certain steps which have lately been made, both because they are remarkable in themselves, and because they help towards the general conclusion to which I wish to conduct your minds.

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The first great step which I will mention is that which is expressed by the terms, *Conservation* and *Transformation of Energy*. I am here using technical terms, and I am not sure whether it is possible to convey to minds which have had no scientific training precisely what is intended by the terms; but perhaps something may be done, and, at all events, it is worth while to try. Of course I might refer you to the Lectures, of which I have already said that I should make use; but I wish rather, if I can, to put the matter in a still simpler form, and to make it to some extent intelligible to persons who would not be capable of reading those Lectures, and similar scientific treatises, with much advantage or satisfaction.

Let us begin, then, with a much simpler example of Conservation and Transformation than that of Energy, namely, the Conservation and Transformation of Matter. It is, I suppose, a familiar thought with most of us, that matter cannot be destroyed. We commonly speak of destruction, but there is no such thing in nature. We burn a piece of wood, or a piece of coal, and the result is to resolve the wood or coal into its constituent parts; but those constituent parts are simply separated from each other, or compelled to combine with other substances; destroyed they never are. There is a story, I know not whether authentic or imaginary, of Sir Walter Raleigh, when smoking in the presence of Queen Elizabeth and her court ladies a piece of the newly introduced

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article tobacco, amusing the royal party by offering to weigh the smoke, the production of which was being watched with so much interest. The court ladies laughed at the promise; but when the pipe was smoked out, Sir Walter calmly knocked out the ashes, and pointed out that if they were weighed, and the weight subtracted from that of the tobacco, as originally deposited in the pipe, the remainder would represent the weight of the smoke. The court ladies laughed again; but clever Queen Bess nodded her head, and said that Sir Walter had performed his promise.

This is a simple instance of the remarkable truth which all reasoning and experience confirms, namely, that matter may be variously transformed, but cannot be destroyed.

Now, that which is true of matter is true in a still more remarkable manner of that which is called *energy*. The word is a technical one, and I cannot very easily go into an accurate discussion and definition of it; but a very simple illustrative example may be given. Conceive two equal inelastic masses, say masses of mud or putty, to be thrown so as to meet each other with exactly equal velocities: the result would be that both will cease to move; because each will convey to the other its own energy, and as these energies are equal, neither can prevail over the other, and the bodies will be brought to rest. If one of the bodies were greater than the other, then the energy of this

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body would survive in proportion to its excess over the other.

It may be said, however, that in this case energy is destroyed, inasmuch as before the collision there were two bodies in motion, whereas after the collision the bodies were at rest, and so their energy gone. This is true ; and the remark leads to the very pith of the subject which I am now discussing. Regarding the question as one of mere motion, it is sufficient to say that each body transfers its motion to the other, and that the result is rest ; but in the process of collision and transference of motion, something else happens : *heat* is generated : it is a matter of familiar experience that to rub one substance against another, or to knock one body against another, produces heat ; and, speaking scientifically, when a body in motion is brought to rest by impact upon another, its energy is converted into heat. Putting this result in a more general form, we are led to say that energy and heat are convertible ; that is, that energy produces heat, and that, conversely, heat may be changed into energy.

Of course I am now giving the merest hint of a grand comprehensive theory ; but you will, I think, easily perceive that the theory, of which this is the seed, may be capable of being worked out completely, and that it may be possible to determine how much heat will be represented by so much energy ; or, on the other hand, how much energy will correspond to so much heat.

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Let me illustrate this by an example. The sun gives out heat at a certain rate. The earth is moving in her orbit with great velocity, about eighty times as fast as a cannon ball: suppose she should impinge upon some immovable obstacle, or, what would be the same thing, upon a body exactly like herself coming the other way, then the heat supplied by this awful collision would be equivalent to that given out by the sun in about eighty days. If we imagine a still more strange catastrophe, and conceive the earth to be brought to rest, and then allowed to fall (as she would) into the sun, the result of her tremendous fall of more than 90,000,000 of miles would be a generation of heat which would keep the sun supplied for more than ninety years. And if the same catastrophe should happen to the planet Jupiter, which is immensely larger in mass than the earth, and much further from the sun, the result would be to produce as much heat as would last the sun, at the present rate of expenditure, for no less a time than 32,000 years.

The result of this law of the Conservation and Transformation of Energy is to give us quite a new insight into the economy of Nature. All kinds of forces are subject to it, whether they arise from gravitation, electricity, magnetism, or what not. Energy can, in all cases, only be transformed: we can no more create it than we can create matter. We burn coal, and we change the heat which we produce into

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steam power: the power of the engine is merely the heat of the coal in another form.

And it is not difficult to see how vast are the fields of inquiry and speculation which are opened by a theory of this kind: it helps us to speculate upon the possible past, and throws also some light upon the possible future. There is just one such speculation to which I will call your attention, in consequence of its great interest.

I refer to the question of the probable extent of time, during which something like the present state of things has existed upon the globe. Sir William Thomson has discussed this question in three different ways; all, however, depending upon considerations of heat or of energy: and the result to which he has come is, that he cannot grant more than about 10,000,000 years for the production of all those results to which Geology bears witness. You may think this a tolerably liberal allowance; but some of the Geologists appear to be of opinion that even 300,000,000 of years would be insufficient for the work to be done which has actually been accomplished. Professor Tait says that if Geology really cannot do without so long a period, so much the worse for Geology, inasmuch as the theory of heat and energy cannot, in its most liberal mood, grant it anything like such a long innings. I do not regret this present apparent conflict between different sciences; it is by such conflicts that truth is not un-

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frequently secured: if upon more careful inquiry it should appear that Geology and other natural sciences cannot have so much time to expatiate in as has been till lately imagined, I doubt not that further investigation will prove that the enormous length of time is not really required; ultimate harmony will assuredly prevail amongst the sciences, however different may be the starting-points of their respective investigations.

Let me say a word here upon the term *Theory*, as I have been lately using it. I have spoken of the *Theory* of the Conservation and Transformation of Energy; and you may speak, if you please, of Mr. Darwin's *Theory* of the Origin of Species, and you may be disposed to say that one Theory is as good as another. But it should be borne in mind that when a Mathematician speaks of a *Theory*, he generally means something different from speculation, different from ingenious guess, different from plausible hypothesis: he speaks of the Lunar Theory, the Planetary Theory, the Undulatory Theory of Light, and so forth, as doctrines respectively concerning the Moon, the Planets, and Light, which can be proved to be true by such evidence as no reasonable man, who follows the steps of the investigation, can find it possible to doubt. These Theories are absolutely different in kind from mere hypotheses which cannot be verified; and it is in this sense that we speak of the *Theory* of the Conservation and

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Transformation of Energy. I cannot, of course, prove to you in an address like this that the Theory is of the kind that I have described; I can only state that it is so received by all competent persons; and that this being so, it must be regarded as a great fundamental truth to which all the conclusions of science must of necessity be subject.

Hitherto I have been speaking, directly or indirectly, chiefly of *heat*: it is the investigation of the nature of heat, principally due (it may be said with satisfaction) to Mr. Joule, a countryman of our own, that has given the enormous advance in our physical knowledge, which I have pointed at, rather than described. Let me turn now to *light*. Heat and light generally go together; and they have both been the fields recently of great discoveries, though in very different ways.

Light, as almost every one is supposed to know nowadays, is due to the vibrations of a fine elastic medium, very much in the same way as sound is due to the vibrations of the air. The undulatory, or wave theory of Light, as it is called, has been for some time recognised as established; and a vast number of complicated phenomena have been worked out mathematically, upon the wave hypothesis, in such a manner as to leave no doubt upon the minds of those who can follow the investigations, that the hypothesis must be sound. Of late, however, the discoveries made concerning the nature of light have been

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diverted, as it were, from light itself to the universe, in which light is so important an agent, in a manner which cannot be passed over by any one who is touching ever so slightly upon recent advances in Science.

Some of those to whom I am speaking will probably be acquainted with the nature and results of Spectrum Analysis; it is a great question whether it will be possible for me to make intelligible to others the principles upon which the analysis is based. I should utterly have despaired of doing so, had it not been for the lucid pages of Professor Tait; whether his light, when further refracted through the medium of my brain, will continue to be luminous may be gravely doubted. But with your kind acquiescence the attempt shall be made.

We will start with sound, the analogy of which with light is frequently most helpful. Every one knows that if he whistles or sings the note to which a tuning-fork, or stretched string, or even a China basin corresponds—the fork, string, or basin will be put in vibration and will give back the sound. Suppose now that you have a box, open at the two opposite sides, and full of tuning-forks corresponding to the same note, and suppose you sound that note: you put all the forks very slightly in vibration. What will be the consequence to a person on the other side of the box? This, that it will be difficult for him to hear the sound which you make; because the vibrations which

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you produce are used up in passing through the box by setting the forks in motion. Any other note the person on the other side would hear quite well: the one note which he cannot hear, which is in fact absorbed, is the one which the tuning-forks would themselves give if made to vibrate.

Now bear in mind the analogy between sound and light, and you will not have much difficulty in perceiving that a certain kind of light, which belongs to a particular substance, may be in like manner absorbed by having to pass through that very substance which would itself emit the kind of light in question.

If I were to go beyond this rough and most elementary, though highly ingenious, explanation, I fear that I should not be able to stop short of a discussion which would be quite unsuitable to the purpose and limits of this address. I shall therefore assume that by means of the scientific apparatus of the spectroscope, it is possible to analyse the light which comes from any luminous source; the light coming from one source is as clearly distinguished from that coming from another, as the sound of a flute is different from that of a violin; incandescent hydrogen gas, for example, will have certain unmistakable characteristics—certain bright lines in its spectrum, as scientific men say—and if other light is made to pass through this incandescent gas, it will produce an effect upon that light, according to what has been already said, by absorbing those very por-

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tions of the light which are characteristic of itself when used as a source of illumination.

Examining the light which comes from distant bodies, by the method of the nature of which I have endeavoured to give just the slightest indication, we arrive at very remarkable results. The Spectrum Analysis enables us to tread with firm step in regions of nature, which previously might well have been regarded as absolutely inaccessible; light is as true a messenger as sound, and in some respects we become as conversant with what is going on in the remote regions of the universe, as if we had correspondents in those regions who could report to us *vivâ voce.*

By this method of investigation we can assert that a variety of substances known upon the earth's surface are to be found in the sun; for example, iron, magnesium, manganese, cobalt, chromium, sodium, titanium, calcium have been identified. And it has been further proved that the sun emits from its surface grand jets of blazing hydrogen gas, some 70,000 miles high.

There is still another application of this kind of analysis, which I will not tax your patience by endeavouring to explain, but the results of which are so curious that I may well refer to them. It is possible by the examination of the light coming to us from a certain distant body to ascertain whether that body keeps its distance from us, or whether it is approach-

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ing or receding. By observations made upon the well-known star Sirius, commonly called the Dog Star, it has been shown that the distance between that star and the sun is increasing at the rate of about 20 miles a second. This increase of separation has apparently been going on ever since Sirius was first known and observed, and yet there is no evidence that the apparent brightness of that star has been perceptibly diminished. I need hardly say what a magnificent conception is thus given us of the enormous grandeur of Sirius, regarded as a luminous body.

But I pass away from this fascinating subject, merely adding that the Spectrum Analysis is almost in its infancy, and that it is impossible even to guess what may be the extent of direct knowledge in store for us with regard to the heavenly bodies, whether stars, planets, or comets, and with regard to phenomena such as the Aurora Borealis, to which an investigation by means of light is applicable. The limits of scientific knowledge, if limits there be, are certainly very far from being yet reached. Newton was nearer to the truth than perhaps even he, with his far-reaching intellect and his modest estimate of himself, was able to perceive, when he spoke of having picked up a few pebbles upon the shores of the vast sea of truth. While, however, this is true, and while we gratefully acknowledge not only the marvellous character of the physical universe, but still more the marvellous gift of intellect which has enabled us to

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comprehend to some extent the wonders of that universe, I think it is well that we should bear in mind, that the ultimate foundation upon which the fabric of nature stands is almost, if not quite, as dark and mysterious and unknown as it was in olden days, before genuine science had commenced its mighty and glorious career.

For what *is* that physical universe which we examine with such care, and in which we make such wonderful discoveries? We know to a great extent of what the earth is made; and, as we have already seen, science has lately been able to tell us something as to the materials of the sun itself; and we are not content with a rough classification of materials, but we have already been able to reduce the ultimate elements of which matter is composed to very few.[1] Possibly the analysis is not yet complete, and conceivably we may arrive at the discovery of one ultimate entity of which every material substance is composed; but what will be the nature of that ultimate entity, and how much nearer shall we be to the first cause and ground of existence, when we have reached this at present distant goal? This is not properly speaking a scientific question. A scientific man would say: 'Such questions are no business of mine; all that I have to do is to go on

[1] 'All organic compounds, derived from the animal and vegetable kingdoms, are composed almost wholly of four elements—Oxygen, Hydrogen, Nitrogen, and Carbon.' — *National Cyclopædia*, Art.: 'Atomic Theory.'

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discovering truth' But the question is one which *I* may very well ask, having reference to the general scope of this address, as announced at the opening of it; and I may ask it in connection with the discussion of the 'Structure of Matter,' which occupies two chapters of the volume, to which I have already referred as my help and companion in the composition of the remarks which I am now laying before you.

I shall pass over the rough suggestions of Lucretius, which, notwithstanding the favour they have lately found in the eyes of an eminent man of science, appear to me to be scarcely worthy of being regarded as even an approximation to the solution of the problem. I pass over also for other reasons the speculations of Newton, Boscovich, and others; and I come to the latest suggestion of all,[1] namely, that of Sir William Thomson, which is, that 'what we call matter may really be only the rotating portions of something which fills all space; that is to say, vortex-motion of an everywhere present fluid.' To say that a suggestion is made by Sir William Thomson is to say that it is worthy of all consideration from scientific men; and to such a jury, rather than to the mixed audience which I have the honour to address to-day, I should be disposed to leave the determination of the value of the suggestion concerning matter which I have just now quoted. In truth, it would be impossible for me, on an occasion like this, even to put before

[1] *Recent Advances in Physical Science*, p. 290.

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you some of the considerations, upon which alone any solid opinion could be formed; but what I wish to bring under your notice is this, that the hypothesis in question concerning matter postulates 'something which fills all space.' What can that something be? If it be not matter, what is it? I do not say that it does not exist, though the actual conception of something filling all space is manifestly impossible to the human mind; the thing may, however, be assumed for argument's sake to be capable of existence, though, in consequence of an inherent infirmity of the mind, this existence may not be thinkable. But granting all that can be required for the purpose of making Sir William Thomson's hypothesis a possible one, do we really do more than drive back the existence of matter one step further? Do we do more than arrive at the conclusion that matter is something, which is something else under certain peculiar conditions? Is not the all-pervading fluid merely the raw material, out of which is formed by vortex-motion those atoms of which Professor Clerk Maxwell has spoken as having much of the character of 'manufactured articles?'

You will understand that I am by no means desiring to speak lightly of this hypothesis. Professor Tait says:[1] 'With a little further development the theory may perhaps be said to have passed its first trials at all events, and, being admitted as a

[1] *Recent Advances in Physical Science* p. 300.

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possibility, left to time and the mathematicians to settle whether really it will account for everything already experimentally found. If it does so, and if it, in addition, enables us to predict other phenomena, which, in their turn, shall be found to be experimentally verified, it will have all the possible claim on our belief that any physical theory can ever have.' This will all be readily granted, and I for one wish the hypothesis all success; but I think I am not wrong in saying, that if it be found to be true, the mystery of existence—the ultimate question, what *is* this material universe?—will be very much where it is now.

All scientific achievement seems to lead to the same conclusion, namely, that human investigation can move freely for a long distance, we know not perhaps as yet how great the distance may be, but that there are certain limits, imposed by Him who made us, which we cannot pass—*sunt certi denique fines.* There is a charming little French book, which I would recommend any intelligent person to read, entitled 'L'histoire d'une bouchée de pain.' It has, I believe, been translated under the literal title, the 'History of a Bit of Bread;' but I should recommend the original, because the French language lends itself with peculiar happiness to the style of exposition which the author has adopted. Let me, however, tell you what the book is, and why I refer to it. It is in reality a popular exposition of the process by which food is assimilated by the living body. The food is

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followed, through all its processes of change, till it is formed into arterial blood, and till in this condition it circulates through the body and supplies the waste and becomes itself transmuted into the various substances of which the body is composed; skin is formed here, muscle there, hair in a third place, nail in a fourth, and so on. But how this is done the ingenious author cannot tell us: there is an absolute hiatus between the manufacture of the material, and the appropriation of the material to its purpose. Here comes in the mystery of *life*: and when we reach that mystery, we seem to find ourselves in sight of a lofty barrier which can in no wise be passed. The existence of this barrier is seen very conspicuously in the 'History of a Bit of Bread,' and that is why I have referred to the book; it illustrates in one familiar department the law which appears to be quite universal, namely, that all nature furnishes us with abundant fields of investigation, that the amount of knowledge to be obtained is practically unlimited, but that in every direction we perceive, if we go far enough, the existence of an absolutely impassable barrier; we become aware that beyond the vast fields of the knowable and the known there is an infinite region of the unknown and unknowable, which the human intellect cannot penetrate, strive and struggle as it may.

This consideration leads to the obvious remark, that it can be no objection to any science that it runs

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into mystery, or involves the unknown or the inconceivable. If this be the case, as undoubtedly it is, with physical science, which beyond all others deals with the seen, the palpable, the sensible, *à fortiori* it is likely to be the case with other sciences, which deal more especially with the unseen and the spiritual. But the analogy of the physical sciences may teach us that, while there are confessed limits to the investigations of the human mind, there are still almost infinite fields of inquiry, which are quite free and open to all comers, and in which admirable discoveries have already been made. To be more definite as to the point at which I am aiming, I would say that there may be a true knowledge of God, a genuine Science of Theology, in which there may be abundance of room for the expatiation of all thoughtful, earnest minds; and yet the science may begin in mystery as human science ends in it; and it may be as wrong to put down theology by the objection that God cannot be known, as it would be to try to hamper physical science by the objection that the nature of Matter is inconceivable. Some would have us substitute for the knowledge of God, in other words, for divine science, what they call *Agnosticism*: the Altar at Athens is supposed after all to have had more wisdom in its inscription than St. Paul supposed; but the fallacy of the proposed substitution is seen, when we consider how easy it is, nay, how necessary it is, for all thinking persons to grant that in a certain

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sense God must be unknowable, and how foolish it is to regard this admission as at all equivalent to this other assertion, that nothing can be known about God. Once more I take the analogy of Physical Science, and I say that Matter is unknowable; but I ask whether this admission proves that no knowledge of Matter is due to the discoveries of Newton, and of all that glorious band of which he may be regarded as the head, that Physical Science is a delusion, and the alleged 'Recent Advances' a dream?

I am thus led to make a few remarks upon the respective origin and principles of each. Dr. Whewell dealt with the whole field of Physical Knowledge, under the title of the 'History and Philosophy of the Inductive Sciences.' Those who have read these works will remember the almost dramatic form in which Dr. Whewell's genius has presented the subject. There is first the prelude to some great discovery, when previous discoveries have turned men's minds in a particular direction and it is felt that some great mental movement is at hand. Then there is the happy thought, the inspiration of genius, what in a lower subject-matter we should call the felicitous guess. Then comes the verification, the appeal to facts, the rigid tests of mathematical calculations and numerical results, and, above all, the prediction of consequences subsequently found to be true. And each discovery reaches on towards some other, and

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even the detection of residual errors in previous conclusions becomes a specially fertile source of further progress. Guessing, doubting, testing, correcting may be said in homely phrase to be the efficient engines of scientific motion; and the Inductal Sciences may find an incidental justification of that name in the fact, that they *lead on* from one point to another, that each discovery induces another, that another, and so on (it may be) *ad infinitum*.

Now, divine science presents a remarkable contrast in regard to the qualities which have just been mentioned as belonging to physics. Divine science is essentially *de*ductive as physical science is *in*ductive: *de*ductive processes are of course required in following out results in physical investigation; and in like manner *in*ductive processes may be available and necessary in investigations connected with certain branches of Theology; but still the basis of divine science does not depend upon happy guesses, nor upon an accumulation of verifications; neither does it offer an infinite field for progress, nor does its success demand that same kind of chronic scepticism which is so useful, or even essential, in the case of natural science. On the other hand, it professes to rest upon ultimate truths, which are made known to mankind either by a moral instinct, in virtue of which man is man, or by that revelation from God which religion necessarily postulates, and of which man alone of all earthly creatures is susceptible.

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I shrink from introducing into an address of this kind illustrations drawn from the highest source of religious knowledge, namely, the message delivered to mankind by Him whom we regard as both God and man; though I would just remark, by the way, that I can find nothing essentially opposed to the knowledge attainable from other sources, in the idea of such a message. But I shall be content with a much humbler illustration of the point which I am endeavouring to enforce just now. I will suppose a father to be walking in the country with young hopeful, aged we will say, twelve years, more or less, and endeavouring to improve his mind. Pater discourses upon geology, and points out various features in the rocks illustrating this or that; he finds, we will suppose, that his companion, instead of swallowing all that is told him whole, bolting it undigested, or apparently regarding the paternal lecture as a bore, asks some awkward but most pertinent question which it is difficult to answer; the boy in fact doubts; he is not convinced by what his elder tells him; he determines to think about the matter, to observe for himself, and then try to make up his mind. What does the father think of this? Is he offended or frightened? Not at all. He says: 'That boy has got the making of a man of science; he will inquire for himself; he will be somebody one of these days.' And papa and mamma rejoice together. But suppose that in the course of the excursion the conversation

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should fall, not upon rocks and stratification, but upon some moral subject, such as *truth*: and suppose that the youth should show himself, like Pilate, sceptical upon *this* point, and that with a precocious freedom of thought he should express the opinion, that there was no great difference between truth and falsehood; and that he should announce his intention of regarding the question of lying as an open one at present, to be decided perhaps in future by observation of consequences. Would the father go home as comfortable under these circumstances as under the former? Would he not see ruin and misery for his son in mature life? Might he not even be tempted to lay the foundation of a respect for truth in an immediate application of the birch rod?

This familiar illustration might be added to and enforced abundantly if necessary; but it will probably be sufficient by itself as an indication of the contrast upon which I am now dwelling. It may be added that, as analogy is not identity, so contrast is not contradiction. I think we may well compare human and divine science, or (if we please so to describe them) physical science and spiritual, to the military staircase which some of us have seen in Dover cliff, or to the similar construction of the famous St. Patrick's well at Orvieto. These staircases are double, and consist of two spirals like each other, supported by one central column, but such that a body of men can ascend by one while another body of men simul-

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taneously and without interference descend by the other: their support is, as I have said, the same; they are inextricably intertwined with each other, and the beginning and end of them are identical, only that one ends where the other begins, and begins where the other ends. The physical sciences begin from below, and wind upwards towards heaven, while religious truth starts from heaven and descends earthwards: but neither needs to jostle with the other, and both in reality revolve about the same central column and rest upon the same foundation.

It is perhaps a misfortune of this particular epoch of scientific history, that one can scarcely speak of the progress of science without being tempted to say something of its moral and religious aspects. If I am not mistaken, there was comparatively little of such temptation fifty years ago. It may be that the particular fields in which science was then chiefly at work did not give occasion to so much anxiety as to a possible collision between human knowledge and divine: it may be that the great popularisation of physical knowledge in latter years, and the consequent approximation of the physical and the moral in the minds of the thousands of intelligent persons who nevertheless have received no real scientific training, may have introduced a danger which did not exist to any great extent before. It may be also that a certain rashness of speculation, and a tendency to introduce speculation into regions which ordinary people pro-

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foundly feel not to be the exclusive property of scientific men, may have tended in the same direction. When, for example, a man of high scientific position announces to us, as a result of his investigations, that our great-great-great-grandmothers were hairy creatures, presumably not very easily distinguishable from certain half-human-looking brutes which may be seen in our own time in the Zoological Gardens—it is not much to be wondered at if many of us should begin to feel that physical science was treading upon somewhat delicate ground. Our fathers perhaps we might have left to take care of themselves; but to give our mothers beards, and to suppose they had sloughed them off only in comparatively late times, in deference to a growing taste on the part of their mates, may fairly be regarded as rather hard to be swallowed, and somewhat unpleasant when it has been. Nevertheless, I am persuaded that in the case of all such bold speculations, our 'strength is to sit still.' No such speculation need ruffle our tempers: still less need it make us full of alarm less important moral or religious truths should be in jeopardy: we may be quite sure that false hypotheses, and unwarranted generalisations, will not live long; that if they have any seed of truth in them, that seed will take root and survive; and that if they are wholly false, they will sooner or later perish altogether. 'Magna est veritas, et prævalebit,' is the motto at once for a student of Physical Science and for a student of

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Theology; it may be written with equal propriety over the door of a lecture-room and over the porch of a church; it ought to be as dear to the President of a Scientific and Literary Association, as it is to a Bishop of the Church of Christ. I am quite sure that the more thoroughly we realise this, and the more completely we agree to regard truth as the common treasure of us all, the greater will be our happiness in seeking that treasure, and the greater our chance of finding it.

But it is time that I should be drawing this address to a close. I have discoursed concerning Science and its advancement, to as great an extent probably as your patience and your courtesy combined are willing to permit; and I feel that, having reference to the title of our Association, I owe a certain amount of apology to 'Literature,' for having paid all my attentions to her younger sister, and for having seemed so rudely to neglect her not inferior beauty and her rival charms. Perhaps, however, I may be permitted to remark, that although our Association describes itself as one for the 'Advancement of Literature and Science,' still, the kind of advancement which is possible, and which is being continually carried out, with respect to Science, is impossible with regard to Literature. Probably no man has ever yet lived who had in greater perfection the true scientific mind than Sir Isaac Newton; certainly no man ever made such advances in science; and yet, by the necessity

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of the case, the science of Newton was but a rude and contracted body of knowledge as compared with the science of those who have stood upon his shoulders, and who have inherited his achievements. And the men of to-day will be but as children by the side of the men of the next century; and many of the grandest and most cherished results of the science of to-day may be looked upon by our successors as familiar knowledge. But in Literature this is not so. Shakspeare occupies in this respect a prouder chair than Newton. Shakspeare may safely smile upon the efforts of Associations for the Advancement of Literature, if by the phrase is meant such an advance as shall supersede 'Hamlet' and 'Macbeth' in the manner in which the 'Principia' and the 'Optics' have been already superseded. There may be an improvement in the general quality of the Literature of a country: the historians may be more candid and painstaking; the novelists may be less trashy, and higher in their tone; the manner and the matter of the thousand and one volumes, which each year produces, may be on the whole in better taste, and of more sterling value: but the giants of the past, specially the giants of poetry, can be surpassed by no process of advancement similar in kind to that which takes place in the case of science; and if ever Shakspeare should find himself second in the list of poets, according to the verdict of English-speaking men, it will be the result of no steady hard-won pro-

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gress, but because some God-sent poet greater than himself has been granted as a gift to mankind.

Here, however, I see the opening of a field of thought upon which I dare not enter. Let it suffice to remark that, if our Association cannot advance Literature, as in fact no association can, it can at least encourage the study of it, and lead people to read and enjoy and profit by those many masterpieces of literary power, which are perhaps the chiefest secular blessing that we possess, and the purest source of intellectual pleasure.

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ESSAY VIII.

NATURAL THEOLOGY.[1]

I WISH to bespeak your patience while I address you on a subject, which, if it cannot be made amusing, may at least be made interesting and certainly is deeply important—I mean Natural Theology.

It is a subject which connects itself easily and simply with the work of a scientific society. The members of a scientific society may, without going much out of their way, very easily and very profitably permit their thoughts occasionally to slip—nay, their thoughts must almost certainly slip now and then—into the subject upon which I propose to speak.

What is Natural Theology? It may be defined to be the knowledge of God as it can be obtained from the knowledge of Nature. It is expressed in the well-known words of St. Paul: 'The invisible things of Him from the creation of the world are clearly seen, being understood by the things that are made, even

[1] This essay contains the substance of an address delivered to the 'Carlisle Scientific Society and Field Naturalist Club,' revised from a newspaper report (1878).

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His eternal power and Godhead.'[1] If the observation of nature leads up to belief, or at all tends to assist and strengthen belief, in the being of God, then it may be asserted with some confidence that nature has been observed to the best and highest purpose possible. But it should be borne in mind, and this is, I think, an important remark, that theology is one thing, and natural science is another. It is most desirable that each of these great subjects should keep its own road. It is desirable that theology should not intrude upon nor obstruct the path of natural science ; and it is equally desirable that natural science should not scowl upon theology. The scientific man, as such, is necessarily not a theologian. The man who studies science, as science, does not regard nature as the work of God ; he regards it simply as that which he can see and observe, which he can reason about, which he can deal with perhaps by means of mathematical formulæ. Great mechanical discoverers, like Newton, for example, or like Laplace, begin with certain principles of mechanics which they lay down. Then they apply these principles to observed facts, such as those which are expressed by Kepler's laws ; and by a combination of their assumed mechanical principles with their observed facts, through the medium of mathematical processes, they deduce results which constitute the science of the motion of the bodies of which the material universe consists, or, as Laplace has called it, 'celestial

[1] Romans i. 20.

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mechanics.' If, on coming to any difficulty in his processes, Laplace should introduce the consideration of God having done this or that, the suggestion might be true in a theological sense, but it would affect the scientific reasoning with a fatal flaw. A scientific man, in his character of scientific man, cannot, by the necessity of his science, introduce into his reasonings any reference to the idea of God.

Nevertheless, the scientific investigator and discoverer may be a very religious, God-fearing man. Everybody knows, at least I suppose everybody knows, that no man had a more profound belief in God than Sir Isaac Newton. And, in truth, though science is not theology, and though, as I have said, it is of extreme importance that they should be kept distinct, and that neither should interfere with the other, still it is possible to make use of the knowledge of nature which has been gained by observation and investigation, for the purpose of looking back upon theology from the position in which science has placed us, and of gaining illustrations of theology from what we have observed and consequently know: in other words, though science may not be confounded with theology, the truths which scientific investigation establishes may be used to help us in knowing more of God, and understanding Him better, than might otherwise have been possible.

If the remarks which have been now made indicate, as I believe they do, the proper relation in which

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science and religion stand towards each other, we shall find in them ground upon which we may secure a good foundation for the subject which is described as Natural Theology. And I think it will be manifest that it is a subject to which either a scientific man or a theologian, or a man who is either both or neither, may very suitably devote some little serious attention. Certainly, if in any one place more than another, Natural Theology can claim respectful consideration, it will be in the city of Carlisle, one of whose brightest ornaments, Archdeacon Paley, is so closely identified with the name and exposition of the subject.

Archdeacon Paley's treatise on Natural Theology is, perhaps, the greatest and most original of all his works: it was the last important production of his mind and pen. It was not composed in Carlisle. The preface shows that it was written at Bishopwearmouth, in the year 1802. The preface is a very touching one. Paley tells us that the Bishop of Durham, who had presented him to Bishopwearmouth, had laid upon him the task of writing a book in addition to those which he had already produced ; and he says that he was glad to do so, because his health was failing and he was unable to perform satisfactorily the ordinary duties of his clerical profession. In fact, he was confined to his study and his books. He suffered much pain, being an invalid for nine years before his death ; and it was in this invalided, suffering condition that he wrote his remarkable treatise on Natural Theology.

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This book may be said to be in a certain sense out of date. People sometimes talk in a rather flippant way concerning the great works of our forefathers. They affect to look down upon them, to patronise them, and perhaps acknowledge with kindly condescension that they were very good considering the time when they were written. But I venture to assert that in some respects there never has been a book, and perhaps there never will be a book, more permanent in its character than this of Paley. It may be antiquated; and in a certain sense it is so; and that for a very good reason. The extent of natural science is now almost infinite, as compared with what it was at the beginning of this century. Paley's observations and instances were confined to a small field: whole sciences have come into existence since his time; had he been able to explore the fields which are now open, it cannot be doubted but that his work would have been more complete than in fact it is. And not only is science more extended than it was in Paley's days, but it is more accurate: observers have been more numerous and more cautious, and each generation of students has had the advantage of entering upon the labours of its predecessors. Moreover, the book is antiquated in another sense, namely, that difficulties have been raised, or have raised themselves, in connection with the subject of which Paley treated, which were unknown to him, may even be said not to have existed, with which, therefore, he could not deal;

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while, on the other hand, perhaps some of the objections to a belief in God which were prominent and operative in his time have mainly vanished, and have given place to others. But putting out of consideration these various ways in which the book is necessarily somewhat antiquated, it may be safely affirmed that the principle of the argument, the general ground of the work, is as sound and good now as it ever was; and it may be added that it would be a useful task, if undertaken by a competent person, to adapt Paley's treatise to the existing state of science: some attempts have been made in this direction, but I believe that the task, which is undoubtedly a difficult one, has not yet been satisfactorily performed.

Let me recall to your minds—I will venture to assume that most persons have read it—the opening passage of the 'Natural Theology:' it is a good specimen of Paley's remarkably clear and vigorous style—a style which probably as much as the clearness and strength of his arguments has tended to give currency to his works.

In crossing a heath, suppose I pitched my foot against a *stone*, and were asked how the stone came to be there; I might possibly answer that, for anything I knew to the contrary, it had lain there for ever; nor would it perhaps be very easy to show the absurdity of this answer. But suppose I had found a *watch* upon the ground, and it should be inquired how the watch happened to be in that place; I should hardly think of the answer I had before given, that, for anything I knew, the watch might have always been

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there. Yet why should not this answer serve for the watch as well as for the stone? Why is it not as admissible in the second case as in the first? For this reason and for no other, namely, that when we come to inspect the watch, we perceive (what we could not discover in the stone) that its several parts are framed and put together for a purpose, *e.g.* that they are so formed and adjusted as to produce motion, and that motion so regulated as to point out the hour of the day; that, if the different parts had been differently shaped from what they are, of a different size from what they are, or placed after any other manner, or in any other order than that in which they are placed, either no motion at all would have been carried on in the machine, or none which would have answered the use that is now served by it. To reckon up a few of the plainest of these parts, and of their offices, all tending to one result: we see a cylindrical box, containing a coiled elastic spring, which by its endeavour to relax itself, turns round the box. We next observe a flexible chain (artificially wrought for the sake of flexure) communicating the action of the spring from the box to the fusee. We then find a series of wheels, the teeth of which catch in, and apply to, each other, conducting the motion from the fusee to the balance, and from the balance to the pointer; and at the same time, by the size and shape of these wheels, so regulating the motion as to terminate in causing an index, by an equable and measured progression, to pass over a given space in a given time. We take notice that the wheels are made of brass in order to keep them from rust; the springs of steel, no other metal being so elastic; that over the face of the watch there is placed a glass, a material employed in no other part of the work, but in the room of which if there had been any other than a transparent substance, the hour could not be seen without opening the case. This mechanism being observed (it requires, indeed, an examination of the instrument, and perhaps some previous

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knowledge of the subject, to perceive and understand it; but being once, as we have said, observed and understood), the inference we think is inevitable, that the watch must have had a maker; and that there must have existed, at some time, and at some place or other, an artificer or artificers who formed it for the purpose which we find it actually to answer, who comprehended its construction and designed its use.

This is the text of Paley's 'Natural Theology.' In the remainder of the chapter he points out a number of circumstances connected with the watch of which the finder may be ignorant, but which could not have the effect of destroying the one grand conclusion, that the watch must have had a maker, and that the maker 'comprehended its construction and designed its use.' We may translate this argument into the language of Natural Theology, and then the general conclusion to be worked out is this, that the material universe, like the watch, has a purpose and had a maker; that it did not come into existence by accident or chance, or by means of anything which may properly be described as natural and necessary law, to the exclusion of a lawgiver or maker. This conclusion is drawn by Paley from a variety of instances and illustrated in detail; and it is worth while for any one who studies natural history to notice the manner, in which the ingenious and useful contrivances with which observation makes him familiar attest the existence of a maker who designed them all. Let us take one instance and discuss it for

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a moment: it may be described as Paley's principal instance: the human eye. Much progress has been made in the science of optics since Paley's time; and in one recent book at least the eye is described as an instrument having defects, of which a modern optician would be ashamed;[1] nevertheless, I cannot perceive that Paley's fundamental argument is weakened, or that the eye is any less wonderful as an optical instrument, or less demonstrative of purpose and of careful construction, than it was when Paley wrote.

Let us consider, then, the human eye. It is manifestly an optical instrument of great complication, and of course it is an instrument which would have been useless had there been no light. But light exists; it would be easy to demonstrate that it existed before eyes; and animals, or (to confine the discussion to ourselves) men, have a machine, which is exactly adapted to the light with which the universe is filled. Now this machine, or optical instrument, has many parts and contrivances. To put the matter very simply, the light passes through a lens into the eye, as it passes through a telescope or a

[1] In his *Popular Scientific Lectures*, Helmholtz writes: 'It is not too much to say that if an optician wanted to sell me an instrument which had all these defects, I should think myself quite justified in blaming his carelessness in the strongest terms, and giving him back his instrument. Of course I shall not do this with my eyes, and shall be only too glad to keep them as long as I can, defects and all. Still, the fact that, however bad they may be, I can get no others, does not at all diminish their defects, so long as I maintain the narrow but indisputable position of a critic on purely optical grounds.'

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microscope, and by means of the lens a picture is formed at the back of the eye on a screen which is called the retina. But the eye has to see at different distances, for which purpose there must be an adaptation of focus. If we wish to see clearly first an object at one distance, and then an object at another distance, we know very well that by an unconscious action of the eye the focus is changed, and clear vision is produced. Again, the eye has to adapt itself to the intensity of the light at any time, or in any given place. If we come into a bright room, or a comparatively dark room, the circumstances of the eye are very different in one case from the other, and we know by experience that the eye adapts itself accordingly; when we enter the darker room all seems at first confused, but soon grows more or less distinct; the aperture by which light is admitted into the eye spontaneously enlarges or contracts itself as circumstances require. Further, in order that the eye may properly perform its work, it is necessary that it should be able to turn with facility in any direction, and we know that it can do this; without perceptible effort we turn our eyes this way or that towards any object which we desire to see. Again, the eye, like any other optical instrument, requires to be kept clean; and there is a machinery specially devoted to this purpose. There is a lubricating fluid in the eye; the lid closes on it when necessary, and so anything on the surface is removed, much in the

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same way as you would clean the object glass of a telescope. Still further, it is desirable that an optical instrument, when not in use, should be shut up in a case to protect it from possible damage. Accordingly the eye, when not used, is shut up in a case; when we go to sleep we do not need the service of our eyes, we close the eyelids, and the eyes have rest and protection till the next morning. Once more, the perspiration which frequently runs down the forehead would run into the eye, and occasion great discomfort, perhaps mischief, if no protection were given; but the protection required nature supplies; we have eyebrows, or brushes, placed in the form of arches over the eyes, which prevent the perspiration from entering. In addition to all this, when the eye has been washed in order to clean it, it is necessary that the superfluous moisture should be removed; and nature supplies a suitable drain. The description of this drain, as given in the 'Natural Theology,' is so characteristic of Paley, and so admirable, that I will give it in his own words:

In order to keep the eye moist and clear (which qualities are necessary to its brightness and its use), a wash is constantly supplied by a secretion for the purpose; and the superfluous brine is conveyed to the nose through a perforation in the bone as large as a goosequill. When once the fluid has entered the nose, it spreads itself upon the inside of the nostril, and is evaporated by the current of warm air which, in the course of respiration, is continually passing over it. Can any pipe or outlet for carrying off the waste

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liquor from a dye-house or a distillery be more mechanical than this? It is easily perceived that the eye must want moisture; but could the want of the eye generate the gland which produces the tear, or bore the hole by which it is discharged—a hole through a bone? It is observable that this provision is not found in a fish—the element in which they live supplying a constant lotion to the eye.

After the light passes through the eye it forms a picture on the retina, which is in fact a kind of expansion into a screen of the optic nerve; the nerve conveys the sensation to the brain, and the fact of sight is produced. And here every scientific man is compelled to leave the question; no one has formed, or perhaps ever will or can form, the smallest conception of the process by which the picture on the retina is converted into the sense of sight.

So much for the eye, and for the manner in which its construction and its various mechanical and other arrangements may be discussed. It is but one instance of the general form of discussion which is applicable to the whole human body, to every animal, even to every insect and plant. The larger investigation of nature which has taken place since Paley's days, though it may have brought to light certain difficulties and apparent anomalies, which he did not suspect, has strengthened, if that were possible, certainly has not weakened, the general force of his argument.

But leaving the smaller things (which, however, are most striking and interesting, and of which Paley's

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book is full), we may with much advantage look out upon the world at large. There is perhaps nothing more difficult to believe than that the world, or say the whole material universe, so beautiful in its form, so complicated in its parts, so marvellous in the ingenuity with which those parts are adapted to each other, should after all be a mere piece of material mechanism, having no moral purpose connected with it. It belongs to a higher order of mechanism than the human eye ; it is difficult to believe that it has no τέλος or end ; difficult to believe that the world, containing as it does beings such as ourselves, is but part of a machine, which, after a certain number of years will come to destruction, as science seems to indicate that it must, and which, when it has ceased to exist, will leave no spiritual mark, and no indication of a high moral permanent purpose having been ever connected with it. Let me illustrate my meaning by an example. Suppose a visitor to go over an English man-of-war, say the *Devastation* or some other monster of modern shipbuilding. He will see much interesting machinery ; the machinery of propulsion, by which the huge ship is made to pass through the water without help of wind or tide ; the machinery by means of which the enormous guns are made easily and perfectly manageable ; the great guns themselves, and the ingenious missiles which can be thrown by them. He will look at all these things, and he will be told that the great guns can throw a

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missile of several hundredweight a distance of several miles. The intelligent visitor will be filled with a proper sense of wonder at all that he is permitted to see; but, if as intelligent as he ought and may be supposed to be, will he not instinctively pass in imagination beyond the mere questions of machinery and of the weight and size of shot and shell? Unless he does this, will not the expenditure upon the ship seem extravagant, and the mechanical skill expended upon the vessel merely wasted? But suppose that he is told that by moving the *Devastation*, and a few more vessels more or less resembling her, into the Dardanelles, the whole policy of Europe can be affected, that the interests of mankind (whether for good or for evil) will be touched by such a movement, will not our visitor feel that an entirely new light is thrown upon the machinery and guns of the great ship? He will say, 'Now I see that this vessel is not constructed merely for the purpose of throwing balls to any conceivable distance, but for a great moral purpose; the intention goes beyond matter and mechanics, and affects the peace of the world, the power and influence of nations.'

As then we detect in armed vessels, themselves marvels of ingenuity and mechanical power, a higher purpose than anything mechanical, for the accomplishment of which the trouble and expense of their construction were undertaken, so we seem to be pressed towards the conclusion that there is some moral

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purpose in the world and the things which it contains: it is scarcely conceivable that the earth should have been called into existence, simply for the purpose of carrying upon its surface even such highly intellectual beings as men are; we need the hypothesis of some great moral or spiritual design, to justify (as it were) the existence both of the world and of ourselves.

Having said thus much concerning the principles of Natural Theology, let me add that it is well to bear in mind that it may possibly be true, as some acute minds have argued, that the being of God, regarded as a bare intellectual proposition, may be incapable of strict logical proof. It is not necessary, however, to conclude from a supposed or even admitted want of logical proof, that it is necessary to have any doubt in our minds concerning the truth of God's being. The question of the being of God has been discussed for centuries, and has engaged the attention of the acutest intellects that the world has produced. It was discussed in olden times by such men as Aristotle and Plato among the Greeks, and Cicero among the Romans. It was discussed by Christian philosophers, as Irenæus, Origen, and Tertullian. It was discussed with marvellous ingenuity by the schoolmen, as Scotus Erigena, our own Anselm, Albertus Magnus, Duns Scotus, Ockham, Thomas Aquinas. It was discussed by the philosophers of the seventeenth and eighteenth centuries, by Bacon, Descartes, Spinosa, Locke, Leibnitz, Voltaire, Hume,

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Samuel Clarke. It has been discussed in our own century by the German school of metaphysicians, Kant, Schlegel, Fichte, Jacobi, Hegel, Schleiermacher. I suppose that a subject which has been so discussed has probably had all said about it that well can be said, or very nearly all. I do not purpose, at all events, to enter upon the argument; but I do wish to lay stress upon the point to which I have referred, namely, that there is great danger of the want of perfect logical demonstration of a positive proposition being regarded as proof that the negative of tha. proposition is true. No greater mistake can be made; and the mistake sometimes leads to sad consequences.

In proof of this let me refer to a book published not long ago, entitled an 'Examination of Theism, by *Physicus*.' The writer does not give his name, and I do not know who he is; but he is evidently an able man. The process adopted by Physicus is this. He collects and considers all the demonstrations of the being of God that he can find, or that he regards as worthy of attention: he overturns them one after another, to his own satisfaction, and, for argument's sake, I will grant that he has succeeded in overturning them: lastly, having done this, he is reduced, as he supposes, to atheism. And then he finishes his book with one of the saddest, most eloquent, and most pathetic passages I ever read, in which he bitterly deplores the result to which (as he imagines) his reason has conducted him. He confesses that he had

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much greater satisfaction and happiness in his old belief; he yearns to believe in God; he seems to think that his soul needs belief; but in obedience, as he supposes, to inexorable logic, he throws over belief, and announces himself an atheist. Now it may be true, at all events I am willing to grant, that an ingenious man may have found a flaw in every one of the so-called demonstrations of the being of God; but how does it follow from this, that he is logically compelled to say that there is *no* God? A thing may be perfectly true, every one may believe that it is true, it may be safe to rest any weight upon the supposition that it is true, and yet there may be much difficulty, perhaps practical impossibility, in proving it. Probability, not demonstration, is the guide of ordinary life. Therefore a man ought not to allow himself to fall into a mental position, against which his soul protests, merely because he conceives himself to have demolished all logical proof of the being of God.

Let me illustrate what I have now been saying, by a few examples.

It has been a question with philosophers whether it is possible to demonstrate the existence of an external world. Suppose, for instance, that I choose to say that I believe that I exist alone, that all that seems to surround me is a phantom, that all which I say that I see has no existence except in my own brain; that I am in a life-long dream; who shall prove the

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contrary? You may say that it is absurd to throw out such a supposition: so it is, so at least I am willing to acknowledge it to be. But this is not the point; absurd or not absurd, if the supposition be made, how can you demonstrate it to be untrue? How do I know positively that I am not in a dream? People often are in dreams so like reality, that they believe what they seem to see to be substantial and real, until they wake and find that they have been dreaming. Therefore the existence of an external world supplies a puzzle, upon which metaphysicians may amuse themselves to the end of time: the problem defies solution, as one to be dealt with by logical processes.

Take another, and what may be called the opposite, case. Suppose I choose to doubt my own personal existence; how is it to be proved? It may be said in this case as in the former, that it is a foolish question for any one to discuss; but if a fool asks the question, where is the wise man who will answer him? As a matter of fact, the problem of demonstrating existence has exercised the minds and troubled the intellects of some of the most profound thinkers whom the world has seen; and the formula in which one of the most eminent, Descartes, has expressed his demonstration, is the well-known phrase, *Cogito, ergo sum*: 'I think, therefore I exist.' Perhaps the reverse order of the words, however, expresses as much truth: *Sum, ergo cogito*: 'I know that I exist, and that is the reason why I can think.' I will not pretend to

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decide whether either or both of these formulæ contain the truth, or which is the nearer approximation to it: but if such questions have been earnestly and seriously discussed by philosophers of the highest order, it is impossible to say that there is no difficulty and that all is clear—clear, I mean, to the philosophic mind; for to the ordinary practical man all may be clear; there may be no atom of difficulty; just as the existence of God may present difficulty to a philosopher, while it may seem axiomatic to the wayfaring man.

There is another problem, to which it may be well to refer, because it has a living importance, as being sometimes pressed in our own day and coming before us practically, and not only as a speculation. How do I know that I possess an independent will? It is well that we should have some kind of answer, and a good answer, to this question; because if we do not possess independent wills, how can we be morally responsible for what we do? Yet it is maintained sometimes that we are virtually involuntary agents: there is a long chain of causes and effects, and we are only the last link in the chain: our conduct is determined by causes over which we have no control, and we are in reality no more responsible for our actions than Vesuvius was for the destruction of Herculaneum and Pompeii. Now, for my own part, there is no persuasion that I hold more firmly than that of possessing an independent will: I would go to the stake

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for my faith in this matter ; life would seem to me not worth living, to be something utterly different and lower than that which may be described as *human* life, if I did not believe myself to possess an independent will, to be able to do or abstain from doing this or that, as I please. Nevertheless, if a man should turn upon me and demand that I should give him logical proof that this is so, if he should require me to upset the argument about the chain of cause and effect and to demonstrate by argument that anything which I do is not the result of this concatenation, but the offspring of my own free will, I candidly confess that I might have great difficulty in putting forward such a view of free will as would be satisfactory to my supposed opponent.

Once more: there is no truth more practically important, more important every way, than that which is involved in the existence of an unseen, spiritual, immaterial world. Belief in this world is the foundation upon which the edifice of society rests, upon which all that is best in the world of matter and sight depends: yet if a man demands proof, if he asks you to make the existence of this unseen world apparent by flawless, faultless logic, what problem can be more difficult, if indeed it be not insoluble? It is partly because of the existence of this logical difficulty or impossibility, that Materialism is at this moment gaining so much influence over many minds. There are other causes at work, but the logical diffi-

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culty of the unseen and spiritual is the reason why these causes are so potent in their effects: the arguments for materialism are simple, on the surface, apparently based on scientific knowledge, and they cannot be at once proved to be deceptive and in opposition to a demonstration of the existence of an unseen world. Any one who wishes to be a materialist may without much difficulty persuade himself of the claims of materialism. I am not now dealing directly with materialism; but I cannot pass it by without remarking that it necessarily goes beyond the denial of the existence of a spiritual world and the consequent cutting away of all human hopes beyond the grave, and involves the denial of God Himself. God is not matter; God is a spirit. If matter be everything, and everything be matter, then it would seem that there is no place for God.

Let me add one other remark concerning the question of a logical proof of the being of God.

Whatever the philosopher may regard as necessary, no man who is content to rest upon the principles of Holy Scripture will assert that any such proof can be required. Nothing can be more remarkable than the absence in Scripture of any attempt at proof: the Being of God is the very fundamental postulate upon which the whole volume stands. It is true that you meet with such language as that already quoted from St. Paul: 'The invisible things of Him from the creation of the world are clearly seen, being under-

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stood by the things that are made, even His eternal power and godhead:' and it may be said truly that the whole science of Natural Theology is contained in this verse; but St. Paul does not reason upon it; he simply takes for granted what most men who think about the mighty and beautiful universe of which they form a part take for granted, namely, that the universe did not create itself, but was created by the power of God. And if we look throughout Holy Scripture, we find everywhere that the being of God is assumed, like the axioms and postulates at the beginning of Euclid, and that what the Scripture undertakes to do is to tell us what God has said and what He has done. 'In the beginning God *created* the heavens and the earth.' 'God *said*, Let there be light; and there was light.' When the law was given from Sinai, we read that, 'God *spake* these words and *said*.' And so, in all the communications to prophets and others privileged to hold converse with Heaven, it is always God *speaking* to them. No attempt to argue the existence of God; but a grand, unique picture presented of God, in the unity of His confessed and acknowledged being, speaking to His creatures and telling them what His will is. This is the principle of Holy Scripture, and it is one upon which we may securely and reasonably rest.

Still further, it may be asserted with confidence that any other principle would be incompatible with religious teaching properly so called. Philosophy is

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one thing—and a very good and valuable thing in its own department—religion is another. Philosophy is based on reasoning: religion is based on faith,—not faith which shall contradict reason, but faith which shall see its way where reason cannot find it, which is sure with a certainty equal to that which reason can produce, and perhaps greater and firmer still, that there is a God—a God who creates, a God who commands, a God in whom we live and move and have our being—faith which will guarantee these grand and mighty truths, even though it be freely granted that logical demonstration cannot be had.

To return to Natural Theology, and the indications of purpose or design which the universe presents.

The great argument of Natural Theology is this: that look where you will, either in small things or great, whether it be the construction of a fly's foot, or the high intellect of man, or the movement of the heavenly bodies, or the universe taken in its completeness, you see everywhere the suggestion of purpose. I quite admit that there are certain exceptions or anomalies, such as the abortive feet of some species of snake (concerning which I have written elsewhere [1]), but I cannot admit that there are any such exceptions as can interfere with the broad conclusion of purpose as the guiding principle of the material universe. But, if you find a purpose, you seem almost compelled to acknowledge a person to whom the purpose

[1] See Essay II., p. 31.

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belongs. Purpose implies person; and he who sees purpose in the universe can scarcely escape the acknowledgment of a personal God. Any other hypothesis may be safely said to involve greater difficulties. I do not say that there is no difficulty in the conception of a personal God: doubtless there is, and must be: a personal God must necessarily transcend all the conditions of the material universe of which we form a part; and therefore it is not possible, in the proper sense of the word, to conceive or comprehend His being. But if we reject the thought of a personal Almighty God, an Almighty Person, making, governing, ordering the Universe, we find ourselves in deeper difficulty still. It is a choice of difficulties. What conception is possible, if you throw aside that of a personal God? That which in these days will most probably be suggested is the hypothesis of matter evolving itself according to what is called natural law. It is not my intention to deal here with evolution; but I must insert a few words bearing upon the subject. I have, if I may use the phrase, a profound respect for matter. Matter seems to me to have been not unfrequently very badly used. Writers have described it as 'brute matter:' they seem to have grudged it every quality except extension and impenetrability, and to have been intensely jealous of conceding to it any 'occult qualities.' Now matter has undeniably some very marvellous qualities, whether 'occult' or not. Every particle of

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matter in the universe attracts every other particle; so at least there is every reason to believe. Each lump of matter upon the earth's surface, even the substance of our own living bodies, is in intimate and definite connection, not only with other lumps of matter upon the earth's surface, but with matter at the antipodes, matter in the sun and moon, matter in the fixed stars. This is a marvellous fact; yet undoubtedly it is a fact. Any one who reflects upon it will be tempted to say that there is something almost resembling a living power in this apparently dead matter. But, granting all this, and with every wish to do honour to matter, I am compelled to say that I can find no evidence of any power in matter to evolve itself into new forms. There is, so far as we know, no power in matter to produce living organisms. Life ever comes from life; and to speak of the world as we see it having been simply evolved out of matter by natural laws, is to say something which does not rest upon an investigation of nature, and the very meaning of which it is difficult to understand. There is no power and no tendency, so far as we know, in matter to evolve a complicated machine like an eye; and the fact that eyes are useful and convenient is not a sufficient reason why matter should evolve them.

It is still more difficult to understand how the great principles which govern human society, and even make it possible, could have been evolved out of

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matter. Human society is held together by such feelings as those of mutual respect, mutual love, honour, obedience, fear. Is there any tendency in matter to produce such feelings? If I am told that anyhow there is nothing in the universe except matter, and that the notion of God is old-fashioned and foolish, one of the childish things to be put away in the manhood of the human race—that in matter exists the potentiality of all life, all morality, all sense of the beautiful, the great, the wonderful,—I reply that, with all desire to do honour to matter, I cannot conceive of it thus. Moreover, I feel convinced that by refusing to acknowledge a living, creating God we fall into a greater difficulty than any which belief in God involves, and that it is much better on the ground of reason to adopt belief in God, rather than to be content with belief in matter only.

Not long ago the centenary of the death of Voltaire was celebrated in Paris. A distinguished Frenchman, in an eloquent *éloge*, spoke of Voltaire's greatness, which he magnified exceedingly; but he confessed and regretted one weakness, and the weakness was this, that Voltaire believed in a God. He explained this weak point by reference to the time in which Voltaire lived, and assured his hearers that had the great man been privileged to live in our own days, he would doubtless have been a sound materialist.

In contrast with this estimate of the tendency of

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exact knowledge of nature, I will quote a short passage from Paley's 'Natural Theology.' I began with Paley: I cannot do better than end with him:—

> If one train of thinking be more desirable than another, it is that which regards the phenomena of nature with a constant reference to a supreme intelligent author. To have made this the ruling, the habitual sentiment of our minds, is to have laid the foundation of everything which is religious. The world thenceforth becomes a temple, and life itself one continued act of adoration.

To which of these philosophers shall we assign the higher place, I will not say for piety, but for wisdom and good sense? I vote for Paley.

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ESSAY IX.

PESSIMISM.

THE writer of an exceedingly interesting article entitled the 'Goal of Modern Thought,' in the 'Nineteenth Century,'[1] gives an account of Schopenhauer and his philosophy. He says: 'We have passed from Shelley to Schopenhauer, from the "Revolt of Islam" to the "World as Will and Intellectual Representation." I purpose in this paper to consider the explanation of the enigma of life which is offered us by the great prophet of pessimism, and the later writer upon whom has fallen his mantle, if not a double portion of his spirit. The new pessimistic philosophy is a fact, and a very significant fact, in the world's history. I shall endeavour, in the first place, to give in as plain and untechnical language as possible some account of its main outlines, and then to estimate its significance, as a fact, in the annals of our time.'

The writer sums up the gospel of pessimism according to Schopenhauer as follows:—

[1] May, 1882.

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Schopenhauer's conclusion is that the world is the worst possible world. Were it worse he thinks it could have no existence at all. Von Hartmann considers that this statement requiries qualification, on the ground that we do not know what is possible. But he earnestly maintains that the world is so bad that it had far better not exist, and that it is steadily becoming worse. But he and Schopenhauer agree that the notion of what is called progress, 'the dream that man will become in some vague future, wiser, gentler, better,' is the master-delusion of the age, for 'the advance of civilisation means but the enhanced capacity of the human race for suffering.' Far other is the outlook on which the pessimistic doctors delight to dwell. They profess a sure and certain hope that the immensity of the world's evil will work out its own cure: that the human race will, in this event, accept the Nihilistic doctrine of the supreme evil of existence and the universal law of suffering, and that, as the visual ray of mankind is purged by these doctrines, men will cease to propagate their species, the human race will disappear, and 'the blunder of existence' will be corrected.

I have not read Schopenhauer, and, as at present advised, do not intend to do so; but I suppose that I am right in regarding him as a leading modern apostle of pessimism, and in believing that the pessimistic philosophy is, as stated above, 'a fact, and a very significant fact, in the world's history.' Pessimism then seems to press itself on our attention, whether it be preached by Schopenhauer or Von Hartmann or any other philosopher, ancient or modern; and it has occurred to me to consider the pessimistic view of the world in reference to theism.

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If the pessimistic view be admitted, what conclusions follow respecting God? Probably most persons would reply, 'Blank atheism, of course.' I am not sure of this; and I think, therefore, that it may be worth while to regard pessimism in its possible premisses and its logical conclusions, and see whether the being of God is got rid of by this terrible hypothesis.

I may observe by the way that an objection may fairly be taken to the description of pessimism as the 'Goal of Modern Thought.' Undoubtedly absolute pessimism may be regarded as the limit towards which much modern speculation tends; you cannot get beyond or below the simple and absolutely worst; but to describe this kind of speculation as emphatically 'Modern Thought' is to do it too much honour. Many profound thinkers of modern times run upon altogether different lines; and there is much modern thought which has no direct bearing upon either pessimism or optimism. Moreover, the word 'goal' seems to imply some prize won, some permanent rest gained, some beneficent or glorious work completed; whereas the conclusion that all is as bad as it can be is essentially a conclusion of perdition, the denial of all possible rest, the negation of all that is beneficent and glorious. It is a goal no doubt so far as a goal is an end, a limit, a terminus; but it is a goal of horror and death.

Nevertheless, the general meaning of the phrase

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is clear ; and looking upon the question from a purely philosophical point of view, and divesting one's mind as far as possible of all consideration of the moral responsibility of uttering the opinion, that God's world is not only imperfect but the worst possible, that human existence is a blunder, and so forth, it may be said that it is well that the unqualified assertion of pessimism should have been once for all made. The assertion touches bottom, though it be an infernal one. We know the worst. Thinkers of the nineteenth century, who have reached this goal, cannot be outstripped in the race by thinkers of the hundred and nineteenth century, if this bad world, and the blunder of existence which it involves, should last another ten thousand years.

Pessimism then has been asserted in these latter days, and has its disciples. Let us look it calmly in the face.

And in the first place it is to be observed, that in discussing the doctrine of pessimism the choice does not lie between it and optimism, using this latter term to express a world perfect in all its moral qualities. Neither philosophers, so far as I know, nor religious men who take their stand upon Holy Scripture and the teaching of the Church, contend for absolute optimism. The contention could not be sustained for a moment ; all teaching, all facts, all experience are against it. Philosophers have had dreams of a golden age, or they have borrowed the dreams of poets,

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who are sometimes the best philosophers: but that golden age has gone by: silver, lead, iron have followed; and the average view of the world has certainly not represented it as perfect—far from it. The amount of evil which presents itself to the most ordinary observer is quite enough to give a hopeless negative to all theories of perfection; and it need scarcely be said that the Scriptures of the Jewish and Christian Churches are based upon the assertion of the entrance of evil into the world and its continued existence amongst us. All things were very good, no original flaw, all evil came from without: it matters not so far as our present purpose is concerned how it came, or whence; come it did with tremendous power, and the bursting in of this flood is the very explanation and justification of the Scriptures as a revelation of the ways of God to man.

Consequently the assertion that this world is very evil—one scarcely knows how evil—is in opposition neither to philosophy nor religion. *Malism*, to use a convenient word, is acknowledged on all hands; while against *pessimism*, the doctrine of a hopeless predominance of evil against which it is of no use to contend, of a fundamental blunder which can only be cured by the extinction of the human race, of a kingdom of the powers of darkness against which it is futile to fight or pray,—against pessimism in this sense most of us would (it is to be hoped) most earnestly recalcitrate. *Malism* may imply that evil

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has come into the world, just as the tares in the parable came into the corn-field, 'while men slept,' by the hand of 'an enemy': it introduces a mystery, no doubt; it brings us into contact with the undeniably strange, but not with the actually incredible; it perhaps cuts ruthlessly across some *à priori* notions. All this may be freely acknowledged; but it is poles apart from *pessimism*. Hope is still at the bottom of Pandora's box; whereas pessimism implies that the whole structure of the world is faulty, and that its architect, if there be one, is no better than a bungler.

Let us look at the last sentence, which I have written carefully, for it contains the root of the whole matter, so far as my present purpose is concerned. Pessimism seems to imply either no architect or a bad one. I have already suggested that it is by no means clear that the former of these conclusions is necessarily the true one. As to the hypothesis of no architect, it may be urged, and I should be willing to allow, that it is inadmissible on all grounds of reason. Atheism will not, as I believe, stand the test of fair argument; it breaks down, it crumbles under examination: but I do not wish just now to go into the whole anti-atheistic argument; all that I wish to press at this moment is this, that although atheism is undoubtedly one of the hypotheses which pessimism may to many minds suggest, it is by no means clear that atheism and pessimism are necessarily and absolutely bound together; so that an atheist must be a pessimist, and

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a pessimist an atheist. Supposing, for argument's sake, atheism to be possible, or rather the world to be possible upon the atheistic hypothesis, it is not, I think, an inevitable consequence that the world would be absolutely evil: indeed, it might be difficult upon the hypothesis of atheism to say clearly what *is* good and what *is* evil; it might be not unreasonably argued that in a world without God there would be no more essential difference between good and evil than between green and red, or between wood and metal. Pessimism, I say, if admitted, does not seem logically to lead to atheism, nor atheism, if admitted, logically to lead to pessimism. Atheism must stand or fall on its own merits or demerits, and may be detached to a great extent from the question of pessimism.

To put this point in another way. Let it be granted as an hypothesis that atheism is possible, or that the universe can exist without a God. Then it would seem to be a question of chance what the universe would be: there being, by hypothesis, no originating mind, no guiding idea, no archetype of things which exist, it would be as probable that the universe should assume or have one form and character, as another. All results would be equally probable; there would be no predominating influence in favour of this rather than that: consequently if the universe, or the world, has a form or character so decided that it can in any way be appropriately described as the worst possible, the logical conclusion would seem to be

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not in favour of atheism—that is, of the absence of an originating cause—but in favour of the existence of some cause which has produced this decided character, though not necessarily of the universe having been originated by an evil principle for evil purposes. I say, *not necessarily*; because it is conceivable that there may be diseases in the universe, as there are diseases in the case of the human body, and the diseased condition may be consistent with the supposition of health as the normal or original condition, just as the existence of disease in certain human bodies is not inconsistent with the truth that health is the normal and proper condition of human bodies in general.

Let us, however, consider in the most general manner possible, all hypotheses which can be made consistently with the assumption of pessimism. These hypotheses are, I think, as follows:—

I. That there is no God.

II. That there is a God, who is either (1) evil, and therefore desiring pessimism; or (2) weak, and therefore unable to check it; or (3) good and powerful, but for some inscrutable reason permitting it.

Let us take these hypotheses in order.

I. I have already shown that atheism is not the necessary outcome of pessimism. But I think any one who may be tempted by the moral condition of the world, which we are all compelled sadly to admit to be very bad, to doubt the being of God, should bear in mind that the theistic argument does not rest

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on moral considerations only. He who would get rid of God out of the universe must reckon with other arguments than those only which rest upon moral considerations. We have to deal with the existence of the universe as a physical fact. We may give up morals for the moment and take our stand on physics. Be the world bad or good, worst possible or best possible, there it is, and there is no denial of its existence. I will not dwell upon the question whether this existence does or does not imply a divine existence; but certainly, if we are to acknowledge pessimism as an argument for atheism, we ought to have pessimism all round; physical pessimism as well as moral pessimism. But so far as the physical aspect of the universe is concerned I cannot understand how pessimism can be maintained for a moment; the mechanics of the heavens, the structure of living bodies, the marvellous adaptation of means to ends, the perfection of contrivance to be noted in the whole economy of plants and insects and fishes and birds, and in fact the whole order of nature, seem to render it impossible for a thinking man not to see in the universe patent and undeniable marks of purpose or design. The existence of a physical Lord of creation presses itself, I think, upon the mind with irresistible force: of course an opposite view is sometimes taken, and those who take it must take it if they will; I believe, however, that the view can never be a common one, and that it will always be the property of a few eccentric.

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minds led away by some peculiar course of study or reasoning: anyhow, I shall assume for my present purpose that the physical argument for a first cause is admitted to be irresistible; and if so, atheism cannot base itself upon a moral argument only. It is something like the case of a house which is in a pessimistic condition with regard (say) to sanitary arrangements: you look over the house, and you say it is 'the worst house possible:' you draw the conclusion that it has had no architect. Is this sound? Look at the manner in which the house is built: examine the woodwork, brickwork, ironwork; all seems of the very best; then you cannot deny the architect. You would not live in the house on any account; but you cannot fail to perceive, not only that it has had an architect, but that the architect has been a very skilful one: you must seek elsewhere, therefore, for the explanation of the pessimistic character of the sanitary arrangements.

I should be disposed to say, then, not only that pessimism does not imply atheism, but that it does not help the atheistical argument in any appreciable degree. If the alternative of God or no God trembled in the balance, pessimism might perhaps turn the scale; but the truth of God's being may be sought and found in the region of pure physics, perhaps even of reason (though that is a point which I shall not discuss), and can be made practically sure without reference to morals at all. And I may add that if the

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character of the first cause, the author or origin of nature, of God, in fact, regarded as revealed by the visible universe, be such as is implied by perfection of physical arrangements, then it may be found difficult to believe that the moral failings manifested in the world are due to moral failings in its author. Perhaps it may be argued that physical optimism does not exist; but there is a sufficiently near approach to it to make us suspect, that moral malism must seek its explanation in something different from evil in the author of the universe.

This last observation, however, is somewhat by the way. My point is that pessimism, even if it could be proved and accepted, would not compel us to believe that there was no God: consequently I dismiss hypothesis I., and proceed to discuss the other possible hypothesis.

II. I have divided my alternative hypothesis into three heads:—

(1) That there is an evil God who desires pessimism.

This is a most excruciating hypothesis. It comes to this, that there is a Being who made the world and declared it very *bad* (compare Genesis i. 31); or if not, who made it with the express intention that it should become very bad. Contrary this, not only to the original declaration that the world was 'very good,' to which I have just referred, but also to that touching outcome of anthropomorphic feeling according to

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which, when mankind became very evil 'it repented the Lord that He had made man on the earth, and it grieved Him at His heart.'[1] The question, however, is not whether the hypothesis is painful nor whether it is contrary to Holy Scripture, but whether it has such an amount of possibility and probability as to be reasonably tenable in argument. It appears to me that it is not tenable; and I am not aware that any speculator could be found who would venture to support it. But it may be worth while to show why it is not tenable; and the argument which I should submit would be as follows:—

If the Being, to whom by hypothesis the world is due, really desired that it should be an evil world, I do not see why his desire should not have been realised to the utmost limit. The pessimism which would result from the deliberate wish and determination of the author of the world would, I apprehend, be something more thorough-going than any pessimism which can be put in evidence. If by pessimism is meant a condition of things which excludes every particle of good, it may be said boldly and at once that such pessimism does not exist. Any one good act or thought done or conceived by any one man since man came upon the earth would upset the charge. No one will be so foolish as to assert that no single man ever did an unselfish action; but one unselfish action upsets pessimism in this extreme sense. To

[1] Genesis vi. 6.

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deny that there are some sparks of good amongst us is simply to talk nonsense ; every hospital, every life-boat, every good-natured smile upon the face of man or woman, convicts the maker of such denial of fatuous absurdity. But if the author of the world wished for pessimism, why did he not execute his wish without stint or limit? Why one single sweet drop in the bitter ocean of pessimism? Why not make evil absolutely and infinitely supreme? It seems to me that there is no answer to this argument: the commonest observations of the world in which we live convince us that the evil in the world is undeniable ; but the commonest observations will also convince us that the evil is not absolutely unmixed, and the slightest admixture of good, the tiniest drop of mercy and charity, one single word or thought of unselfishness, one deed of noble self-sacrifice, is sufficient to blow into space the horrible conception of a creator who desires and designs pessimism.

We may pass, therefore, away from the hypothesis of a God such as this.

(2) The second head of my alternative hypothesis is,

That there is a weak God, and one therefore unable successfully to oppose pessimism.

This hypothesis, though a strange one, is rendered in a certain sense respectable, in virtue of being patronised by J. S. Mill. He writes as follows :—

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One only form of belief in the supernatural—one only theory respecting the origin and government of the universe—stands wholly clear both of intellectual contradiction and of moral obliquity. It is that which, resigning irrevocably the idea of an Omnipotent Creator, regards Nature and life not as the expression throughout of the moral character and purpose of the Deity, but as the product of a struggle between contriving goodness and an intractable material, as was believed by Plato, or a Principle of Evil, as was the doctrine of the Manichæans. A creed like this, which I have known to be devoutly held by at least one cultivated and conscientious person of our own day, allows it to be believed that all the mass of evil was undesigned by and exists not by the appointment of but in spite of the Being whom we are called upon to worship. A virtuous human being assumes in this theory the exalted character of a fellow-labourer with the Highest—a fellow combatant in the great strife; contributing his little, which by the aggregation of many like himself becomes much, towards that progressive ascendency, and ultimately complete triumph of good over evil which history points to, and which this doctrine teaches us to regard as planned by the Being to whom we owe all the benevolent contrivance we behold in Nature. Against the moral tendency of this creed no possible objection can lie; it can produce on whoever can succeed in believing it no other than an ennobling effect. The evidence for it, indeed, if evidence it can be called, is too shadowy and unsubstantial, and the promises it holds out too distant and uncertain, to admit of its being a permanent substitute for the religion of humanity, &c., &c [1]

It will be obvious that some portion of the view of religion here put forward by Mr. Mill can be accepted frankly by those who receive the New Testa-

[1] *Three Essays on Religion*, p. 116.

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ment. The notion of working with God, and finding honour and pleasure in the co-operation, is one put forward emphatically by the Apostles; 'workers together with Him,' writes St. Paul;[1] this has been the inheritance of the Church of Christ ever since. The point at which every Christian, and, as I think, every sound philosopher, would part company with Mr. Mill is that which attributes imperfection to the Divine Being, and which grounds the necessity of human co-operation not upon the will but upon the weakness of God. Is the conception of an imperfect, weak, limited Divine Being one which we can admit as reasonable, when we turn it round and examine it? I think not.

With regard to the Divine nature it seems to me to be true that there is no resting-place between zero and infinity. Zero, the absolute denial of God's Being, atheism, or whatever it may be called, appears to be capable of being received by some minds, for some profess themselves to be atheists. This view may be capable of easy refutation or not. I hold that it is; but that is not the question just now. I am dealing at present with the man who does not accept atheism, but who rests upon belief in the existence of a limited God: where can this limit be placed? You speak of a weak God, but what is the measure of his weakness? How can the line be drawn, or even imagined, between what he can and what he cannot do? If

[1] 2 Cor. vi. 1.

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there is a limit, is it possible to conceive of this limit being always the same? Can we get rid of the notion of growth and failure, of increase and decrease; and when once this is admitted can we get rid of the notion of utter collapse and even entire extinction? All this seems incompatible with reasonable ideas of God.

Moreover, if we once admit the notion of limitation it is difficult to exclude that of plurality. If there be one weak God, that is, one God whose powers are limited in some particular way, why not more than one? And if you once admit polytheism, do you not accept theism in name and deny it in reality? If you have anything of the nature of a Pantheon, you may be a 'worker together' with one God, and a worker against another: Jupiter may wish one thing, and Mars or Apollo the opposite. The admission of limitation seems to be hopelessly liable to this objection.

I do not intend to assert that the existence of beings different from ourselves is either impossible or incredible. There may possibly be beings so ethereal and superhuman that a million may be able to stand upon a needle's point; and there may be, and probably are, beings to whom the laws of matter are altogether inapplicable. But then these beings are not divine; they are part of the great universe, seen and unseen, to which we ourselves belong. The existence of such beings postulates an origin, as does the existence of man: if you try to conceive that which has no origin,

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but is the origin of all things, you can admit of no limitation, no plurality ; you must 'believe in *one* God, the Father Almighty, Maker of Heaven and Earth.'

Let me digress for one moment for the purpose of noting the marvellous philosophical depth of the announcement made by Moses to the Israelites on the subject of the Being of God. Learned writers may discuss as they please the origin of the name Jehovah, and may endeavour with or without success to identify it with the name of God used amongst some other nations ; but nothing can detract from the philosophical profundity of the announcement, 'Hear, O Israel, the Lord thy God is one Lord.' One God, one Lord, is not a mere arithmetical proposition ; it is the assertion of the being of the Absolute, of the Almighty, the Eternal, of Him with whom in the nature of things there can be none coordinate, none comparable. The possession of this truth raised the Israelites at once to a high position in the scale of humanity ; they became philosophers without knowing it ; slaves as they were when they first received the revelation, they became free with the freedom of God ; they stood, as it were by miracle, higher by head and shoulders than all their brethren.

It was on the strength of this great truth, promulgated again when human folly had practically much weakened its force, that Mahomet went forth conquering and to conquer. If we ask why it has been that the result of Mahomet's monotheism has

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been so degrading and so disappointing, we may find the answer to the question in the neglect of the further revelation of God made by the Incarnation. The monotheism of Mahomet was, so to speak, out of date; it was practically retrograde, rather than progressive; it contradicted much which men had learned; it stood apart from much co-ordinate truth; and so it ultimately failed terribly. Yet even as it was, the declaration, 'There is but one God,' had an electric effect upon mankind; and even now, in the midst of all the degradation and evil with which the religion of Mahomet is accompanied, there is a life and power in the belief of one God, as held by Muslim and manifesting itself in Muslim worship, which astonishes every Eastern traveller.

We may put aside, then, as utterly untenable the hypothesis of a weak God who cannot carry his good purposes into effect.

(3) There remains but one other hypothesis for our consideration. I have already stated it thus:—

That there is a good and powerful God, who, for some inscrutable reason, permits evil to exist.

I have introduced the word *inscrutable*, because it seems to me that much of the difficulty, besetting the attempt to frame a theological system which the intellect can entirely adopt, arises from the assumption that we have faculties by means of which we can entirely comprehend all the elements of the system. In the language of Mr. Mill, quoted above,

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a certain form of belief in the supernatural is the only one free from intellectual contradiction; my own persuasion is that the form in question is *not* free from intellectual contradition; but suppose it were, would this prove that it was true? And may it not be possible that what is true may involve in a very real sense intellectual contradiction,—not of course contradiction such as a *reductio ad absurdum* in geometry, but contradiction such as is involved in the transference of the subject into a region in which the intellect cannot follow? Try to conceive what would happen if you started vertically from the earth's surface, and progressed uniformly in a straight line. What would you come to? You cannot imagine; yet the motion itself is perfectly conceivable. Or try to conceive the totality of material existence: there must be a total, and therefore you can conceive an envelope which shall contain the universe; but what will there be outside the envelope? You cannot say. Or, again, think of the ether which fills all stellar space, and to the vibrations of which light is due; what is the limit of this subtle ether? has it a limit? what can it be? how can it be contained within this limit, and what exists beyond? The intellect simply breaks down. And if the intellect breaks down in attempting to conceive merely physical things, why should it be an invincible argument against a moral or spiritual hypothesis, that in its presence the intellect breaks down?

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But in reality much may be said in favour of the hypothesis of a good and powerful God, who permits evil to exist. Let us regard the hypothesis as follows:—

If it be argued that the outcome or offspring of an all good, all wise, all powerful Being must be all good, it is a sufficient answer to say that we have no such knowledge of the subject as can justify us in declaring *à priori* what *must* be. But while shrinking from unwarranted assertions, we may fairly speculate that the highest outcome of Godhead will probably be the production of a creature having an independent will. Now it is the introduction of an independent will that is at the root of the evil which is in the world: if we look at those parts of creation which are purely and simply physical and mechanical, we find nothing to suggest pessimism, not even malism; taken as a piece of mechanism the sun and planets, to go no further, may be described as an exquisite work; any one who has read Laplace and Lagrange will agree to this; but supposing there was to be an outcome of divine power in a physical form, is there any difficulty in believing that a mere perfect piece of clockwork, a skilful mechanical arrangement, would fall short of that which the divine will required? Would such an outcome commend itself, even to our own imperfect appreciation, as a worthy representation of divine power? Some of us may be able, for anything that I know to the contrary, to conceive of

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deity as permanently passive, but there is no proof that such a condition is possible ; and if it be not, if, on the other hand, constant activity be an attribute of deity,[1] then can we conceive such activity as being expended entirely upon machinery, and not upon that higher kind of development which is emphatically *not* mechanical, and in whose unmechanical character its essential superiority consists ? Might not such an exertion of power be compared (I write it with reverence) to a man employing himself in the production of toys, instead of devoting himself to the higher concerns of life ? If so, are we not driven to conceive of God as causing independent will to enter as an element into His creation ? We seem, I think, to be shut up to this conclusion, and it is a conclusion fraught with tremendous results. Mechanical action, or any action according to imposed law, is one thing ; the action of will is another. And though the latter is grander, higher, every way more wonderful than the former, beyond all possible comparison, it involves tremendous potentialities which the other does not. A bright, intellectual, highly-endowed boy may delight a father's heart, but also he may break it ; if the boy had been born an idiot, he would have done neither the one nor the other ; but would the father have chosen, if he had had the power of choice, that his son should be born an idiot, or even a dullard, for fear of the abuse of his powers ?

[1] S. John v. 17.

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We have, then, the hypothesis of a creative power coming into active operation, with the additional hypothesis of the created thing having, as one element of its being, an independent will. But if there be an independent will, how can it be tried, how can it be shown that it *is* a will, that it *is* independent, unless there be some method of trial, in fact some opportunity of doing right or wrong? Hence, we seem to desiderate as a further hypothesis some condition of trial. I do not think that it matters much what the precise condition of trial is; but some condition there must be, if the will is to be really independent and free.

Are these hypotheses conceded? Observe, they are put forward only as hypotheses, which may be reasonably conceded as probable, not as propositions which cannot be doubted or denied. With this understanding I will regard them as conceded; but in the concession is included the possibility of any amount of evil; the concession involves the admission of the possibility of that which technically or theologically is called *sin*, that is, the opposition of the will of a creature to the will of an Infinite Being to which it ought not to be opposed; the concession opens the floodgates to a stream of evil the strength and depth of which cannot be predicted; it admits the possibility of the world becoming very bad, though the heart and mind revolt against the notion of its being actually the worst possible, so long as it is in some kind of

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living connection with a Being who is all powerful and all good.

Though I desire to confine myself as strictly as possible within the limits of pure reason, and though the suggestions offered have the same value and the same weakness (as the reader pleases) whatever we may think of the will and deeds of God as purporting to have been revealed, I yet cannot refrain from remarking upon the striking resemblance between the result of speculation and the actual assertions of Holy Scripture. God is represented in the opening chapters of Holy Scripture as creating a good world, and as crowning His creation with a moral agent having an independent will. Further, this will is represented as being tried and going wrong; all the evil in the world is described as resulting from a selfish use of this independent will. Now I am not intending to follow these beginnings of human history into all their consequences, nor to hint at any promised regeneration of the world; but certainly it is worth while for men who talk so glibly and so confidently, as some do in these days, of the exploded fallacy of what was once called revelation, to notice that the evil condition of the world, the doctrine of sin, the assertion of a fall from original righteousness and purity, are the basis of the religion which has done most to make the world better; to notice, moreover, the account of the origin and *rationale* of this evil condition as given in a manner so dignified and

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so simple, at the same time so telling and so philosophical, that modern philosophers can scarcely pass it by, or affect to look upon it with contempt—I say advisedly, *so philosophical.*

I have now completed the discussion of pessimistic philosophy which has suggested itself to my mind, and which I have thought might be useful to a certain class of readers. But before laying down my pen I should like to say, that the mere fact of believing in pessimism does not seem to me to be the worst feature of Schopenhauer's view of the world: malism is admitted on all hands, and the degree of malism which any thinking person may feel compelled to accept depends upon many circumstances; even the same mind will take different views at different times; and so much are the strongest amongst us subject to material influences, that it is difficult not to allow that the state of a philosopher's liver and stomach have sometimes an effect upon his speculative opinion concerning the moral condition of the world. Certainly temperament will influence the opinion, and so will the experience which a man may happen to have had of the world and of his fellow-creatures. Malism, pejorism, pessimism: positive, comparative, superlative: where and how shall we draw the line?

Draw it where you please, or where your mature judgment leads you to think that it ought to be drawn; but, however near the extreme of pessimism

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the line is found, let not the conclusion be one of blank despair. The notion of the dreadful evil of the world being brought to an end by the human race ceasing to propagate itself is as grotesque as it is foolish: but it suggests two thoughts. In the first place, is not the love of life which is so characteristic of humanity a protest against the notion of the condition of the world being so bad that it ought to be brought violently to an end? The value and dignity of human life assert themselves even in the look of joy and thankfulness which lights up the countenance of a criminal, when he expects sentence of death, and hears the judge pronounce *only* penal servitude for life. Human life is not likely to come to an end by a happy despatch executed under the influence of despair, when every miserable unit of life is to itself so precious and so dear. In the second place, when the extirpation of life is recommended as the only cure for the evil condition of the world, is it not worth inquiring whether in reality the world's condition is not in many important respects better than it was? No one would argue that the world is such as good men would wish it to be; its defects, its miseries, its pollutions, are too patent to be denied; but has not a great amelioration taken place in historical times? is not the condition of things now such in most parts of the world that the good outbalances the evil, that the good is gaining ground, that it is possible for men in general to lead a life in

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accordance with the highest views of what is worthy of humanity? However this may be, I should not feel disposed to find fault with the intensity of the judgment which any man may pass upon the evil of the world, if he strives to keep free from the evil himself, and to cure it for others, so far as he may be able. It has been the sense of the power of evil in the world, and the misery which exists far and wide, that has nerved almost every effort yet made to improve the world's condition. The emancipation of slaves, the preaching of the Gospel of peace to wild tribes, the self-denying exertions of those who have laboured in countless ways to alleviate the sufferings and improve the condition of their fellow-creatures—all these and the like deeds of heroism have found their origin and their life in the belief of the world's evil and misery. I can accept such pessimism as this: it is not the pessimism of cowardly distrust and despair; it is the pessimism of faith, hope, and love.[1]

[1] When the above Essay was written I had not read the *Ultimatum of Pessimism; an Ethical Study*, by James William Barlow, M.A. I have read it since with much interest, but do not feel disposed to modify what I had already written.

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ESSAY X.

EVOLUTION AND *EVOLUTION.*

NOT long ago I was requested to give a short address during the dinner hour to the workmen employed in the Atlas Works, Manchester. It so happened that, a few days before that upon which the address was given, I received by post (it was not the first time that such a thing had happened) a bundle of leaflets containing Infidel or (so called) Freethinking matter. Much of the contents was of the usual kind; very positive, to Christian minds very painful; and abounding in assertions capable of receiving simple and satisfactory replies; I do not say entirely unsuccessful in suggesting difficulties; for difficulties are abundant, easily suggested, and recognised as existing by believer and unbeliever alike. But in glancing through the leaflets, which some unknown hand, for some unknown purpose, had sent to me, my eye fell upon the assertion that the discoverer of the principle of 'natural selection' was as great a man as he who gave us the Lord's Prayer. This assertion struck me as a useful text for my little

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address to the workmen in Manchester. Accordingly I adopted it as the basis of my remarks; and I endeavoured, while declaring my belief that Mr. Darwin would have shrunk with horror from such a compliment, to show that the discovery of any scientific truth and the giving of the Lord's Prayer belong to two different departments, incapable of being compared the one with the other; and while expressing my reverence for all human discovery, I enforced upon my hearers the fact that there is a knowledge of God for which the human soul craves, which Christ has given us, and for which no scientific results can by possibility be regarded as a substitute.

A day or two after the date of my address, I received a letter from a working man, in which, after referring kindly to my visit, he said that I had not told them whether I did in fact believe in evolution or not. The charge, if I may so call it, was a true one: there was no time, even if I had wished it, to enter upon so large a subject as evolution; but besides this, it was better for my argument that the truth or falsehood of evolution, and especially of evolution by natural selection, should be left out of consideration. The greater part of my remarks were equally effective whether I believed in evolution or not: my point was that the region to which the Lord's Prayer belongs is different from and higher than that in which natural science is found, and that the comparison between any man of science and Him whom

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Christians recognise as their Divine Lord is one which on all grounds ought not to be made. Whatever may be the case as regards Mr. Darwin, we all believe in the truth of the discoveries of Sir Isaac Newton, and yet I suppose that most of us would shrink from a comparison of the discoverer of universal gravitation and the author of the Lord's Prayer. Nevertheless, I feel disposed to take up my friend's challenge, and to endeavour to explain to what extent and in what way I believe in the doctrine of evolution. To tell the truth, I have for some time been more or less intending to set down on paper a few thoughts upon this subject; it has seemed to me probable that to do this might clear my own mind, and perhaps help to clear the minds of others. The question, Do you believe in Evolution? is one which cannot be answered in a single word or even in a few words; there must be not a little explanation and qualification, in order to make any answer to the question satisfactory, either to the person to whom the answer is given or to him who gives it.

I therefore describe this paper, in which I am about to attempt some kind of answer to the question, Do you believe in Evolution? by the title 'Evolution *and* Evolution.' I do this because I have been led to the belief, that there is, on the one hand, a sense in which the doctrine of evolution is undeniably true, while, on the other hand, the term evolution may be taken, and frequently is taken, to imply hypotheses

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which have not been substantiated, and which probably are incapable of being so. Evolution, for example, by no means necessarily involves 'natural selection;' neither is it necessary for a person, who believes in the origin of species by natural selection, to be content with natural selection as the only cause at work in the origination of species; Mr. Darwin did in fact supplement his hypothesis of 'natural selection' by a subsidiary one depending upon sex; and there seems to be no reason in the nature of things why these hypotheses should not have been further multiplied, if others had suggested themselves to Mr. Darwin's mind. Hence it is necessary to deal with the question of evolution in the broadest manner, and it may be well to observe that when so dealt with it may be to a great extent separated from the name of Mr. Darwin. There is abundance of evolutionist doctrine which has nothing to do with his special investigations, and there is some against which his own speculations are a distinct protest. What Mr. Darwin did was to suggest a mode by which evolution might be conceived to take place. The suggestion has been widely received; and the reception of the suggestion has had the effect of drawing more attention, than was previously conceded, to evolution in general, as a principle or law of the material universe.

Taking the word *Evolution* in its broadest meaning, it implies that an existing state of things is such

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as it is by growth and change from a state of things previously existing, and not by any sudden call to existence.

Regarded thus it is manifest that evolution is the general order of nature. Plants, animals, rocks, are equally evolved out of something which previously existed; the seed germinates, and, by methods agreeing in the main but varying in detail in different plants, becomes at length the complete vegetable or shrub or tree; in like manner the bird is evolved from the egg, and mammals produce young after their kinds; and it requires only the most ordinary powers of observation to perceive that the rocks bear testimony to pre-existing materials, out of which they were formed. This kind of evolution, with which we are all familiar, may suggest, and perhaps has suggested, that other kind of evolution which has been so much before the minds and in the mouths of men for some years past. May it not be that the universe, as we now see it, has been evolved or developed out of something previously existing? Is it not probable that this world, for example, instead of starting into being with birds'-nests already built in the trees and dams tending their young, according to the poetical dream of Chateaubriand, was in reality evolved by slow processes from antecedent conditions which reach back to Chaos?

It will tend to a clear comprehension of the subject, or at all events of the view of the subject

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which I wish to expound, if we consider evolution in two or three distinct ways.

In the first place let it be observed that there are cases in which a process, which may be properly described as evolution, is nothing more nor less than a demonstrated fact.

The best illustration is that which is supplied by geology. I suppose I may take it as conceded on all hands, that the examination of the earth's crust has demonstrated, that, going backwards in time from the present epoch, the earth's surface has carried upon it different faunas and floras at different epochs. The length of time during which man has existed upon the earth is at present an open question: on the one hand there is no doubt but that the duration of this existence is much greater than it was formerly believed to be; on the other, it is equally certain that the longest period, which any geologist would assign, is short compared with the whole period during which life has manifested itself upon the earth. Before the appearance of man we find evidence of the earth being peopled with living creatures, of what may be intelligibly described as lower and lower types: we have strata in which the living creatures had much in common with those which exist upon the earth's surface at the present day; then strata which have less in common; and so on, till we arrive at strata indicating an entirely different condition of life; and at length we lose sight of life altogether. This,

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roughly speaking, is the tale which geology tells us. Concerning the general correctness of the facts thus revealed, there can, I suppose, be no doubt: the earth's ancient history is written in the rocks in characters which cannot be destroyed, and which are capable of clear interpretation as to their general significance, though there may be difficult or even unintelligible passages here and there.

This being so, just reverse the order of thought. Instead of beginning from ourselves and the world which we see, and tracing back the earth's history to the azoic rocks, start with those azoic rocks and ascend to the existing world. What is the result of this reversal of the order of thought? Why, that beginning with a condition of the earth's surface exhibiting no life, you ascend from the simplest living forms to those which are more and more complicated, higher and higher, as we may properly call them, until you reach the head and crown of all, in which man is seen as the highest of all creatures. Now there seems to be no reason to suppose, that this change in the occupation of the earth's surface has not been continuous. It is not long since a different view prevailed amongst geologists; it was thought that the earth bore testimony to successive creations of higher orders each than that which preceded it, and that each creation having lasted its time was swept away to make room for the next: but this opinion has given way before the accumulation and

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comparison of observations; I think I am correct in saying that no geologist now maintains it: on the other hand, it may be regarded as a truth universally admitted by all those whose admission is of any value, that the change in the nature and character of the creation by which the earth's surface has been occupied, has been of an orderly, continuous kind, without violent break or cataclysm.

But to say that this continuous change is the result of geological observation, is virtually to assert a doctrine of evolution. Nothing is said as to the manner in which the evolution takes place, nor as to the power which effects it. Evolution, as here presented, is simply the expression of a fact supposed to be demonstrated by observation. I may, however, observe by the way that if we look to what we see in our ordinary experience of nature, we may find enough to prevent us from being astonished by any changes which may have taken place in past times. The bird has been a spot in an egg; the oak has been an acorn; the butterfly has been an egg, a caterpillar, a chrysalis; the frog has been a tadpole; and so forth. I do not say that we can argue from these facts, that evolution has taken place in anything like the same way with regard to species; but I do think that the exceedingly strange metamorphoses of insects and reptiles may serve to guard us against rashly dogmatising as to the impossibility of any change, which may be alleged on scientific evidence to have taken

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place in past ages. But whatever may be the value of this suggestion, the statement already made is true, namely, that to assert evolution in the sense in which I have now been asserting it, is only to express in one significant word the demonstrated history of the earth.

What Mr. Darwin did was to suggest a way in which it might be conceivable that this evolution came about. Other suggestions had been made before; one especially may be noted, because it excited for a time much controversy and warmth of feeling, namely, that contained in the anonymous volume entitled 'Vestiges of Creation.' The hypothesis of the 'Vestiges' never gained much hold, perhaps on scientific minds none; it had not a single fact to which to appeal; it was ingenious and imaginative, and nothing more. It may be regarded as now dead and almost forgotten. The advantage of Mr. Darwin's hypothesis is, that, although it too is confessedly wanting in facts by which it can be fully substantiated, it nevertheless can be said to be suggested by experiment and observation. Remarkable transformations can be put in evidence as having taken place, for example, in breeds of pigeons; remarkable changes are made in domestic animals by the art of man; and when the possibility of change is once conceded, there is much in the simplicity and steady self-acting character of the hypothesis of natural selection to recommend it for adoption, not to mention that Mr. Darwin's sin-

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gular qualifications as a naturalist, his acute powers of observation, his great zeal and industry, and his remarkable modesty, all tended much to gain favourable consideration for any speculation or hypothesis which approved itself to him. I shall have more to offer concerning the hypothesis of 'natural selection' hereafter; at present let me say candidly that the conclusion to which I have been brought after long consideration is this: the hypothesis seems to me to be entirely inadequate to explain the facts of the case. I do not deny that 'natural selection' may be a fact and an important fact, or that selection in relation to sex may be another fact, and that also an important one; but acknowledging such facts as these as important, I cannot perceive that they adequately account for such results as the existence of man; they seem to me to be at best what may be called modifying circumstances in the great drama of evolution, to which geology bears witness: there is, so far as I can judge, nothing in the hypothesis of natural selection which can be regarded as taking the place of a creative cause working according to a fixed purpose, or a distinct preconceived plan.

Leaving, however, this view of the subject for the present, let me make a few remarks arising out of what I have said concerning evolution as being in a certain sense a fact to which geology testifies; in other words, as being a mere presentation of admitted geological truths.

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In the first place, it should be observed that there is nothing in such a statement opposed in its spirit to, rather is the statement in remarkable harmony with, what we read in the first chapter of the Book of Genesis. I cannot too heartily protest against the notion of that chapter being regarded as a scientific memoir: I am surprised when I find persons in our day who wish to upset belief in the Lord Jesus Christ, attempting to strengthen their cause by representing the Almighty as performing the work of creation (so to speak) with a human hand, and by the time of a modern clock; such interpretations of a noble document, which, in the nature of things, cannot be a scientific statement, indicate either ignorance, or a willingness to turn solemn things into ridicule, or an unscrupulous desire to overthrow the faith of the simple. Nevertheless, if we take a general view, such a view as alone we could be intended to take, of the creative picture which the writer of Genesis has set before us, we cannot but be struck by the gradual progress from lower to higher, from simple to complicated, which forms so marked a feature of the creative days. It is according to the spirit and genius of the poetic narrative that the creative power should be attributed, without reference to secondary causes, to the Supreme Will, to the Word of God; but so far as the result is concerned, we may say most truly that, if geology testifies to evolution, so does Genesis. The gradual progress from lower to higher forms

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which you find in one, you find also in the other: if you describe the changes to which the rocks bear witness by the name of evolution, there is no reason why you should not apply the same name to the changes which are described in the creative days of the first chapter of Holy Scripture. The difference between the two modes of viewing the subject is just this—that Holy Scripture attributes the progressive changes to a spiritual power, as for its purpose it was bound to do, whereas geology gives a simple result and there leaves it.

But I pass on from the consideration of Holy Scripture to remark upon two or three things in which, if I am not mistaken, we may observe what may be called evolution, and in which also we may see something similar to natural selection and the survival of the fittest. I may add that, from noticing the part played by natural selection in these and similar cases, we may perhaps find help in forming a judgment as to the sufficiency of such an hypothesis to bear the burden sought to be laid upon it by some modern scientific writers.

Look at history generally. If there be truth in the principle of natural selection and the survival of the fittest, the principle may be expected to manifest itself in the regular course of history; it ought to appear as a potent mover and determiner of events; organisations which are better than others ought to survive, good methods of government, true principles of commerce,

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right views concerning society and the relation of man to man, ought to indicate their superiority by exhibiting superior vitality. And in a limited sense and degree this probably is found to be the case; but it is only in a limited sense and degree. There are other influences at work, which probably, in the long run, are more practically potent,—the human will, the human passions, the exceptional strength of individual men, an Alexander, a Julius Cæsar, a Napoleon, a Cromwell—influences of this kind come in, not so much as disturbing forces, but as the principal leading, overwhelming, first-rate forces, by which the direction of the stream of history is governed. There are other forces which must not be left out of the account: history is affected by climate, by religion, by peculiarities of blood, and by many other things; but without attempting to enumerate them all, it is quite certain that, while on the one hand it may be rightly said that upon the whole good has more vitality in it than evil, that right is more powerful than wrong, still, on the other hand, it would be the mere folly of a doctrinaire to assert that history evolved itself purely and simply according to the law of the survival of the fittest: it would be well for the world if this doctrine were universally true.

Take one particular example of history; let it be that of the British Constitution. It is the peculiar blessedness and strength of the British Constitution that it *has* a history; that it is not a mere paper constitution made to order, like so many of which we

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have heard, and which have scarcely survived their birth, or at all events have succumbed to the first attack of disease, but is distinctly a growth, or, if you please, a result of evolution. In this case we may find very much which may be described as the result of the survival of the fittest; experiments have been made, have failed, and been abandoned; much has been tentative, the Constitution has none of the appearance of a work made to order, *teres atque rotundus*, but is more like an old oak tree, beautiful without symmetry, strong by means of unseen deeply-reaching roots. Yet how utterly any genesis of the constitution depending upon the principle of the survival of the fittest would fail! If such a principle would explain its growth or evolution in Great Britain, why not in France or Spain or Italy? Is it not evident that to rest upon this one principle, the value of which I am, however, by no means denying, would be to leave out some of the most powerful factors, such as the genius of the people, the religious influences brought to bear upon them, the character of their great leading God-given men, even their geographical position and their climate? I am willing to grant that a principle analogous to that of the survival of the fittest has had something to do with the evolution of the British Constitution; I entirely deny that it has been the sole cause, or even the chief cause, of the evolution.

Look again at the history of religion; and in so

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doing it is convenient, or indeed almost necessary, to confine our minds to our own religion. At all events, the history of our own religion will best illustrate the point which I have in hand. The advantage of this choice is, that we have the history in a volume with which we are familiar, the Holy Bible. And you will observe that in speaking of the history of our religion as contained in that book, I am not for my present purpose compelled to enter upon any discussion of the truth or falsehood of that religion; whether a man accepts the religion or not, he will not (if be he in his sound mind) deny that the Bible gives us substantially the history of the manner in which the religion came to be what it is. Accepting then this history, tracing the religion as it starts from Abraham, develops with the patriarchs, takes form under Moses, expands first into the Temple worship, then into the Temple plus the Synogogue, in which condition it was found when Jesus Christ was born, and out of which condition incontestably grew the Christian Church—tracing this history from Abraham to the Apostles, you cannot fail to observe the law of growth or evolution; each step (so to speak) made the next step possible; the end was causatively connected with the beginning; the Church of Christ was regarded, by those who in its origin knew most about it, as the fulfilment of the promise made to Abraham and the Fathers. An admirable example of evolution, if there ever was one; for surely it was by a survival

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of the fittest, that the 'rude and beggarly elements' gave way to something so much more spiritual than themselves, that the bloody sacrifice of beasts was replaced by a 'pure offering,' that the Jewish temple and synagogue became the Catholic Church: I cannot imagine in the historical region a more favourable example of evolution by the survival of the fittest. Yet if we confine ourselves to this one principle, where are we? The plain answer is that we are nowhere at all. Look at the great human agents of the evolution, and it will be seen that this is so. Abraham and his remarkable life can be accounted for by no such principle. Neither can Moses; at least if his survival, when so many were destroyed, was due to his beauty, and so, in a certain sense, to his fitness to survive, this mere survival in babyhood does not explain the wonderful career reserved to him as a man. Least of all, with reverence be it spoken, will any hypothesis of the survival of the fittest explain the life and ministry of Jesus Christ our Lord and of His Apostles after Him. As I have already said, I do not think that it would be possible to find in the historical department a more favourable example of evolution by the survival of the fittest, than that which is to be found in the growth of that which now we call the Christian religion: but it seems to me to be obvious, that, even if we agree to put out of sight for the time the motive hand of God as the true cause of growth, and restrict ourselves to those outward causes

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which the historian can observe and chronicle, we shall be unable to resist the conclusion, that the chief causes of growth are of a class which cannot be comprised in the formula, 'survival of the fittest.'

It is unnecessary to pursue this part of the subject further; it may be sufficient to remark that the history of civilisation, the history of commerce, the history of language, and many others, might be examined with a prospect of coming to the same result.

And let me say that if the hypothesis of evolution be granted, with a reserve as to the manner in which it comes about, and even with an avowal of entire want of confidence in the principle of 'survival of the fittest' as the only or even the chief cause to which evolution is due, we shall satisfy all the present demands of science and be in harmony with many of those who are regarded as the chief exponents of the doctrine. In proof of this, let me quote a passage from a recent work, entitled 'Chapters on Evolution,' by Dr. Andrew Wilson.[1]

It requires (writes the author) to be pointed out, that whilst the general truth of evolution is now admitted by all competent biologists, there exists considerable diversity of opinion regarding the exact factors to which the processes of modification are due. Thus the title of Mr. Darwin's classic work is *The Origin of Species by Means of Natural Selection; or the Preservation of Favoured Races in the Struggle for Life*; and such a designation indicates with sufficient clearness that it was to 'natural selection' that Mr. Darwin attributed the chief power in evolving new

[1] P. 5 (Chatto & Windus).

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species through the modification of the old. Mr. Wallace accepts 'natural selection' as a true factor, but he does not regard it as operating to the same extent in evolution as did Mr. Darwin. Other biologists, again, are inclined to adopt the idea that the evolution of living beings follows particular lines, along which the process is guided or directed partly by internal causes inherent in the constitution of the living being, and partly by external causes and the surroundings of life. Concerning the relative importance of the various factors which biologists regard as of importance in determining the process of evolution, Huxley remarks that 'the exact place and power of natural selection remains to be seen. Few can doubt that, if not the whole cause, it is a very important factor in that operation, and that it must play a great part in the sorting out of varieties into those which are transitory and those which are permanent. But,' continues the high authority, 'the causes and conditions of variation have yet to be thoroughly explored, and the importance of natural selection will not be impaired, even if further inquiries should prove that variability is definite, and is determined in certain directions rather than in others by conditions inherent in that which varies. It is quite conceivable that every species tends to produce varieties of a limited number and kind, and that one effect of natural selection is to favour the development of some of these, while it opposes the development of others along their predetermined lines of modification.'

I think it will appear from this extract that I have not yet advanced anything which scientific men have cause to regard as heretical. I now proceed to regard evolution from another point of view. In the physical example of geology and in the moral examples of history, civilisation, religion, and the like, there is unquestionably a progress from lower to

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higher types, which may probably be described as evolution or growth. There are also examples of what may be called probable evolution, that is, of facts which may be explained upon such an hypothesis, though it may not be possible to offer any absolute proof of its truth.

The example which I have chiefly in mind is that which is supplied by the formation of our own globe, and generally by that of the planetary bodies. Geology carries us back to extremely remote ages in the earth's history, but mathematical investigation carries us back very much further still. The solid globe which constitutes the inhabited world can be traced with much probability to a previous condition, in which life must have been impossible: the process by which the earth passed from one condition to the other may properly be termed evolution.

I refer to the hypothesis that the solid earth was originally a fluid mass, and that its form is due to its rotation about an axis. If the earth and all the other globes which are visible to us were perfectly spherical, we should seem to desiderate a reason why they should have that form rather than any other. Early speculators would no doubt have seen in the simple symmetrical form of the sphere some fanciful reason why worlds should have been that form rather than any other; but the earth has not an exactly spherical form; it is spheroidal, slightly flattened at the poles, and the amount of flattening agrees admirably well

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with the supposition, that the earth is a fluid mass revolving about an axis with precisely that amount of angular velocity with which the earth actually revolves. Hence, as we are compelled to seek some reason why the earth should have the form which it has, and as the hypothesis of a fluid mass of matter in a state of rotation appears to satisfy all the essential conditions and to involve no insuperable difficulty, we rightly adopt it, at all events provisionally.

It is difficult to say how far we may go back, with anything like safety or probability, in tracking the process according to which the visible universe came to be what it is. The furthest point possible seems to be reached, if we adopt the hypothesis, originally suggested by Laplace, according to which all the heavenly bodies have been originally nebulous, and have assumed their present form by a process of conglomeration and contraction. This hypothesis is sometimes spoken of as an established theory ; which is perhaps going too far : for my present purpose, however, I am under no temptation to contradict it ; let it be granted as fully as its most ardent supporters can desire. Nevertheless, it will be seen that the hypothesis will not stand by itself ; it no more contains an account of the origin of the universe than the hypothesis of the earth's figure, to which I called attention just now, contains an account of the origin of the world ; the hypothesis of the earth's figure as depending upon rotation is an hypothesis of the earth's

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figure and nothing more ; it does not pretend to account for the varied phenomena which the earth presents ; it only suggests as highly probable the hypothesis that the particular form of the earth is due to centrifugal force (as it is called) influencing a fluid mass. In like manner the nebular hypothesis may be admitted as probable to a high degree of probability ; but it does not account for the existence of the material universe in its present form ; in fact, no cautious person would suppose that it did.

Only consider what the material universe is, the complicated and delicate nature of its machinery, the elements which it involves,—light, heat, electricity,—the forces which are in action, the order which pervades the whole system, above all, the phenomena of life, wonderful in their simplest manifestation in plants and insects and beasts and fowl, infinitely more wonderful when seen in their highest human manifestation, reaching out into a region beyond that of matter, touching the moral, the spiritual, the divine—consider all this, and then you will see how impossible it is to conceive of a nebulous evolution as accounting for the universe, or as taking the place of the fundamental conception of a creative mind. Grant that the solid earth was at one time nebulous, as probably it was, call the process by which it has become what it is Evolution, if you will, but you do not get more than a few steps nearer the beginning, and the problem of creation remains exactly what it was. I confess that

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I am entirely amazed when I find scientific writers asserting, as some of them do, that the hypothesis of evolution is the solution of the mystery of the universe, and that belief in an intelligent creator belongs to the past.

This remark leads me to speak of evolution in that sense in which it is neither proved nor proveable, and in which it is, manifestly, as I think, false and mischievous. Suppose it to be stated, that, given matter and law, evolution will explain the universe, then, if I am asked whether I believe in such evolution, I reply, 'A hundred times, No.' All that the hypothesis of evolution can do is to explain the manner (and that only partially) in which the universe came to be what it is. Evolution contradicts the hypothesis, for example, of instantaneous creation; apart from examination and study and comparison of observed facts, it might be open to any one to speculate that the world came into sudden existence, exactly in its present condition, by the power of God: few people who believe in an Almighty God will deny that this might have been so, had He so willed: but the use of our eyes and our reasoning powers proves to us, that as a matter of fact this was not so; nature does nothing, speaking generally, by sudden leaps and bounds; all is quiet progression, change, growth; the coals that we burn bear witness to an enormously distant epoch of the past, when this chilly country of ours enjoyed tropical heat, and the form of our globe (as I have

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already explained) bears strong testimony to the earth having assumed its form upon principles understood by every mechanic. Thus you rightly introduce the thought of law and evolution into the problem of creation: but the problem of creation itself still remains essentially what it was; to ascertain a few steps of the process by which a thing is done, by no means explains the ultimate source of the power by which it is done, much less does it justify you in denying the existence of such a power. All that a believer in God can mean by professing belief in evolution is this, that he regards it as fairly proved by scientific observation and reasoning, that the process which we describe as evolution is that according to which God works.

This being so, I confess myself unable to understand such statements as the following, which I quote from a writer in the 'Encyclopædia Britannica.'

> It is clear (he says) that the doctrine of evolution is directly antagonistic to that of creation. Just as the biological doctrine of the transmutation of species is opposed to that of special creations, so the idea of evolution, as applied to the formation of the world as a whole, is opposed to that of direct creative volition. It substitutes within the ground that it covers the idea of a natural and necessary process for that of an arbitary volitional process.[1]

Now observe. In the first sentence of the paragraph just quoted, the writer tells us that the doctrine of evolution is antagonistic to that of creation; and this he explains by saying that it substitutes the idea

[1] Evolution: *Encyc. Brit.*

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of a natural and necessary process for that of an arbitrary volitional process. I somewhat object to the introduction of the words 'natural and necessary,' as descriptive of a process which is merely the result of observation; but I let that pass, for the purpose of testing this dictum concerning creation by applying it to a simple case. Before the time of Newton, it was well known that the planets described ellipses about the sun; men, who believed in God, believed that they did so in accordance with His will. But Newton showed that they did so because the particles of matter, of which the sun and planets are composed, mutually attract each other according to the law of the inverse square of the distance. I suppose we ought to say, in accordance with the sentence quoted, that Newton substituted 'a natural and necessary process for an arbitrary and volitional process;' but do we say so? Is there any one who thinks that the transition from Kepler to Newton means a loss of belief in God? Did Newton think so? I do not deny that the first reduction of the mechanism of the heavens to mathematical rules and formulæ, as was done in Laplace's most wonderful book, had an effect of causing an outbreak of infidelity, just as the publication of the doctrine of evolution has in our time; but men soon perceived that infidelity, founded upon accurate knowledge of celestial mechanics, was a mere ghost or bogie; no one would be likely now to be deprived of his faith in God by his knowledge of the

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mechanism of the starry heavens; and so I trust that the time will soon come, when no scientific man will commit himself to the statement, that the idea of evolution is antagonistic to that of creation.

For when we talk of natural and necessary processes, what do we mean? What of life? It is a simple scientific fact, that life has never yet been evolved in any material substance which had not in it the element of life already. Consequently, we need life as the start of the evolutional process, and we cannot get it out of evolution. But granting life, to tell me that man has been produced by a natural and necessary process without any volition, appears to me to be the assertion of something so amazing, that it cannot be accepted without the clearest proof. Yet what proof can be given? It cannot lie within the limits of natural science, for natural science knows nothing about volition; and if we go into the region of philosophy, we shall still, I think, find it difficult to persuade wise, sensible, thoughtful men that there is no volition, no purpose, no design, no ultimate end, connected with the wonderful material universe of which we form a part.

And if this be so, I think I am justified if I speak of the view of evolution, which I am now discussing, as not only false but mischievous.

If we regard physical hypotheses simply as physical hypotheses, they are all innocent and justifiable. The wildest hypothesis may have some element of

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truth in it, and may be the means of leading to further truth. And we may be quite sure that any hypothesis which does not stand on a sure basis will fall sooner or later. Hence we do wisely never to look with dread or suspicion upon the hypotheses and speculations of scientific men. But in order that physical hypotheses should be regarded with entire charity, they ought to be purely physical, and ought not to trench upon moral and religious ground. When a scientific man, therefore, tells me that evolution is antagonistic to creation, I have a right to say, 'What do you, as a scientific man, know about creation?' If he tells me that observation shows that creation was carried on in one way and not in another, I thank him for what he tells me, and consider him as within his rights; but if he tells me that there is no such thing as creation, and that science has substituted the idea of some natural and necessary process for it, then I protest against his going out of his province and saying what is unphilosophical and mischievous. Unphilosophical, as I think I could easily show; but I rather lay stress on the word 'mischievous,' because this is much the more important word. If there be no volition in the world, nothing but natural and necessary processes, what becomes of the foundations of morals, the difference between right and wrong, the spiritual side of human life, the old and comforting belief of an unseen Heavenly Father? This is no imaginary danger; some scientific men do tell us, in so many words, that

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the world is without purpose, that what has been called the moral order of the world is all nonsense, that there is nothing but matter and law and evolution. Does not one's blood run cold at the thought of having to live in such a comfortless, hopeless, Godless world?

I am aware that some philosophers have attempted to supply a system of morals and sociology based upon materialistic conceptions of the world. Whether such a system can ever be made to take the place of the two great commandments, 'Thou shalt love the Lord thy God with all thy heart and soul and strength,' and 'Thy neighbour as thyself,' I am not proposing to inquire; but I should certainly be glad to be assured that some system of morals can be devised, which plain men can understand, before we sacrifice the old commandments upon the altar of evolution. I should be still more glad to make it clear, that the conclusions of physical science may be cordially received by us all, without the necessity of accepting doctrines concerning the power of God in creation and concerning His moral government of the world, which have nothing to do with physics and belong to an entirely different department of human thought.

It is only just to Mr. Darwin to say, that the antagonism between evolution and creation cannot be credited to him, if we may judge from the striking

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paragraph with which he concludes his work upon the 'Origin of Species.'

It is interesting (he writes) to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and so dependent on each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; inheritance which is almost implied by reproduction; variability from the indirect and direct action of the external conditions of life, and from use and disuse; a ratio of increase so high as to lead to a struggle for life, and, as a consequence, to Natural Selection, entailing divergence of character and the extinction of less improved forms. Thus from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is a grandeur in this view of life, with its several powers, *having been originally breathed by the Creator into a few forms or into one*; and that whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.

Originally breathed by the Creator—let those who tell us that evolution and creation are antagonistic consider and weigh those words. And let the words be dwelt upon, because they are so distinctly anthropomorphic; that is, they adopt phraseology taken from human action for the purpose of expressing that which is divine: how else can the divine be ex-

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pressed? If there be a God at all, it is manifest to any one who reflects, that there is no possible method of describing His deeds, or His nature, excepting that of adopting language appropriate to man: those who use such language know well that they are speaking figuratively; but they can find no other way, and they are content to express themselves in a manner which plain men can understand, and to which philosophers have no real cause to object. Even in describing human things we are compelled to speak in a gross material fashion, when we deal with the spiritual part of man: we speak of sorrow breaking the heart, of hardhearted and gentlehearted men, of finding ourselves on unsafe ground, or making a slippery statement in an argument, or of a man who does a foolish thing having lost his head, or of a knight fighting for a lady's hand, and so on, *ad infinitum*; we cannot avoid this figurative language, and it answers its purpose completely; why then should we be overwhelmed with the terrors of that terrible word *anthropomorphism*, if we say that God spake the word and that *so* all things were created?

I have given to this paper the title 'Evolution *and* Evolution,' and I have already explained why the title was given. But a further light may be thrown upon the subject, by observing that the article on Evolution in the 'Encyclopædia Britannica,' from which I have already quoted, has been contributed by two writers, between whom a very instructive

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contrast may be noticed. Evolution *and* Evolution in this article are described as 'Evolution in Biology,' and 'Evolution in Philosophy.' The former, by Professor Huxley, is a distinctly scientific treatise; he deals with the evolution of individual things, and the evolution of the sum of living beings; he expounds the views of Mr. Darwin and of other workers in this department, and, on the whole, presents a view of the subject in which much may be regarded as proved, while a certain portion contains hypotheses which it will be for future investigation to confirm or set aside. It is not in this portion of the article, which breathes the true spirit of science, that the rash remarks concerning creation, upon which I have already commented, are to be found; they belong to the portion which deals with 'Evolution in Philosophy,' and I am desirous of pointing out the difference of the atmosphere in which we find ourselves when we arrive at this point. The following is the definition of evolution:—

> The modern biological doctrine of evolution which regards the higher forms of life as gradually arising out of the lower, owes its chief philosophical significance to the fact that it renders definite and precise one part of a general theory of the world viewed as an orderly succession of events or as a process of becoming. This theory is put forward as an answer to one of the two problems of philosophy conceived as an interpretation of real existence. The first of these problems concerns itself with what may be called the statical aspect of the world, and inquiries into the ultimate nature of all reality (matter and mind), viewed as coexistent

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and apart from time. The second problem treats of the dynamical aspect of the world, and has to do with the process by which the totality of things has come to be what it is, and is still being transformed. It is this latter problem which the various theories of evolution seek to solve.

This is the hazy commencement of what I am compelled to describe as a hazy treatise. If I am asked whether in this sense I believe in evolution, I find it difficult to give an answer. I do not know exactly what it is in which I am asked whether I believe or not. When I read that 'Evolution is almost synonymous with progress,' I am disposed to give a hearty assent; but when I find a few lines lower down that 'the doctrine of evolution is directly antagonistic to that of creation,' I am compelled to retract the assent already given. But I need not follow this writer any further; I only wished to illustrate my position as to the different ways in which evolution may be presented, by contrasting the manner in which the subject actually is presented by two writers who combine to write an article. The moral that I draw is, that evolution may mean something which every one will accept, when he knows what the thing meant is; it may mean something which can be put upon such scientific evidence, that every competent judge will admit its truth; it may mean a speculation having some plausibility, but no ground of actual demonstration; and it may mean some bold assertion which has no foundation whatever, and which in the

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interest of science, morals, and religion we are bound to do our best to explode.

With these hints I must leave the subject. It is a difficult one, and I fear it may have proved a dry one; but it is an important one in these days of abundant literature, and of rash assertion, and of organised efforts to destroy men's faith in God. I have done my best to give an answer to my Manchester friend's question; and I will conclude my answer by saying, that I do believe in a progressive creation, the manner and laws of which are matter for investigation and are being investigated; and that at the same time I believe—with as simple a heart as when I learned my catechism from my mother's lips, and at the same time with the full assent of those mental powers with which God has blest my manhood—'I believe in God the Father Almighty, Maker of Heaven and Earth.'

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FUNERAL SERMON FOR CHARLES DARWIN.

PREACHED IN WESTMINSTER ABBEY ON SUNDAY, MAY 1, 1882.

'Complete in Him.'—COLOSSIANS ii. 10.

AMONGST other solemn words which were uttered upon the solemn occasion which filled this church with mourners on Wednesday last were these:—'The Lord gave, and the Lord hath taken away: blessed be the name of the Lord.' These words, if accepted fully, and pronounced firmly, must often require the exertion of strong faith. To acknowledge that God has in wisdom and in love taken away some one, whose life seemed to be unspeakably precious, and whose death is an unspeakable bereavement to a family, or a disaster to a nation, or a loss to the world—this is no easy thing for a thoughtful and honest man or woman to do. Neither do I think that our Heavenly Father, Who knows our infirmities, and above all Who knows that 'it is He that hath made us, and not we ourselves,' will be extreme to mark what is done amiss, if we candidly confess that our hearts will not unreservedly accept,

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and that our lips will not distinctly pronounce, the words. It is one thing for the reason to say that all things are under the government of an All-wise and Righteous Ruler, and that, therefore, whatever is is right; it is another thing for the heart and feelings to yield a full assent. It is one thing for a believing soul to take its stand upon the revelation which God has made of Himself; it is another thing to stifle such feelings as those, which, on a notable occasion, called forth the touching complaint and lamentation, 'Lord, if Thou hadst been here, my brother had not died.'

But there is a portion of the funeral sentence quoted by me just now, which, perhaps, on most occasions is almost forgotten by the side of that other which speaks of bereavement and loss. 'The Lord hath taken away.' There can be no question concerning that part of the assertion: the living man is gone: his earthly joys and sorrows and labours and troubles have come to an end: upon him 'the night' has come 'in which no man can work:' and the Lord has done it. You may look, and, of course, you do look, to secondary causes: a constitution impaired by study, or an inherited infirmity, or a severe cold caught by imprudent exposure, or the natural decay of age, or a railway accident, or what not: any one of these may be the immediate cause of the assemblage of a sorrowful group at the burial of one who is gone. But if this world be under the

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government of a Supreme Ruler, still more if that Ruler be one without Whom 'not a sparrow falls to the ground,' then when you have cleared away all the veils which the material conditions of human existence have interposed between you and God, you must come to the ultimate truth, that it is He and no other Who has 'taken away.' But the certainty of this truth, and the painful manner in which a funeral brings it home to us, should not prevent us from realising that other side of the truth—that God was the original Giver of that which has been taken away. Surely as we walk round this church and look at the monuments which it contains—memorials of great poets, and great statesmen, and great discoverers, and great commanders, and patriots, and philanthropists—memorials of the great and good in all the varied forms in which greatness and goodness happily manifest themselves in this world, which contains so much that is neither great nor good—surely the impression made upon our minds must be, that these great and good men are nothing else but the gift of God? Shakespeares and Newtons would be inconceivable in a world that was not governed by a loving Father. I do not know upon what principle such gifts are given, any more than I know why it is that monsters in human form have been permitted from time to time to lay waste God's earth and to spread misery amongst God's creatures; but if I try to devise a theory of man and his origin and his

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destiny, which shall not involve belief in an Almighty and All-merciful God, it is man himself that stands out as the greatest and most insuperable difficulty in the way: great and good men seem to postulate the existence of an All-great and All-good God: and so when I see in Westminster Abbey the memorials of those whom God has taken away, I forget the loss in the recollection of the original gift; the congregation of such memorials in a house dedicated as this house is, in a house which we call emphatically the House of God, the giving back the mortal remains to be deposited in this hallowed spot, 'in sure and certain hope of the resurrection to eternal life'—all this seems to emphasise the truth, that good and great men are in a very real sense the best gift of God. 'The Lord *gave*: blessed be the name of the Lord.'

Such remarks as those which I have been making might, perhaps, be not unsuitable in connection with any interment within the walls of this church. To me at least they seem to contain essentially Westminster Abbey thoughts; something of the kind must, I think, almost of necessity suggest itself as part of the manifold contemplations, which seem to grow spontaneously within the walls of this solemnly suggestive building. But I conceive that it is a duty necessarily imposed upon him who occupies this pulpit to-day, that he should say something more immediately bearing upon the funeral of last week, and

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upon him whose mortal remains were then deposited with so much honour and by so many mourners. It is always a difficult and delicate task to speak concerning the departed; besides the well-known maxim which tells us that we should say concerning the dead nothing but what is good, there is the duty also of saying nothing but what is true, what is necessary, what is wise, and what is profitable. It is obvious that in the present instance the always difficult task is not less difficult than usual.

Let me say, in the first place, and in general, how much I think that the interment of the remains of Mr. Darwin in Westminster Abbey is in accordance with the judgment of the wisest of his countrymen. It would have been an unfortunate thing, if it had been supposed that he himself or those dearest to him recognised an incompatibility between the results of his scientific studies and the solemn committal with prayer and thanksgiving to the ground of that mortal material frame which had done its work. It would have been unfortunate, if anything had occurred to give weight and currency to the foolish notion which some have diligently propagated, but for which Mr. Darwin was not responsible, that there is a necessary conflict between a knowledge of nature and a belief in God. On the other hand, it was a happy thing, and one of good augury for our country —of good augury, perhaps, for the world—that it should be thought suitable to bury the remains of

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the most conspicuous man of science in this generation with the fullest expressions of Christian hope, that no objection should be offered by those who had the power of objection, and that the course so taken should commend itself to the conscience of the country. A distinguished man who was present at the funeral remarked to me, that as he witnessed the ceremony he felt thankful for his native land. 'Had this death,' said he, 'occurred in France, no priest would have taken part in the funeral, or, if he had, no scientific man would have been present.' I imagine that there was much of mournful truth in this remark. Thank God that no such remark would be possible as applied to England! God grant that such possibility may never arise!

This is not the place, nor this the occasion, nor am I competent, to speak of Mr. Darwin's position and merits as a man of science; moreover the accurate evaluation of the position and merits of every remarkable man must be left chiefly to posterity; time alone can try the real strength of a reputation. For us, however, it is sufficient to observe, that beyond all doubt and question Mr. Darwin has been the means of producing a greater change in the current of thought on certain subjects than any other man. He did it by perfectly legitimate means; he observed nature with a strength of purpose, and a pertinacity, and an honesty, and an ingenuity, which have never been surpassed, and upon his observations

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he based his hypotheses and theories. He was fully within his right in doing so. Time will test the correctness of his results; some may become established, some may prove untenable. The laws which Kepler thought he had discovered did not all survive; Descartes' vortices have passed into oblivion; Newton's hypothesis concerning light has yielded to that which he thought he had weighed and found wanting; but meanwhile it is thus by careful questioning of nature, and by freedom of speculation, and acute suggestion, that true knowledge grows and thrives: we may be quite certain that a theory with a flaw in it will sooner or later cease to be a theory: a baseless hypothesis will sooner or later be seen to be baseless: those who are not scientific themselves—and the mass of mankind never can be—but who imagine that the progress of science involves dangers to truths which to the mass of mankind are immeasurably precious, need not be over anxious and unhappy. Speculations, unless they contain truth, will never be long-lived; and if they do contain truth, then they have in them a life which nothing can destroy, and with which no wise man would wish to interfere.

This much in general is suggested by the memory of the illustrious dead. In particular may I say, how much we may all learn from the example which he has given us in the duties of life? I think it is generally the case with great men, that while there is much in them which ordinary folks can only admire

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at a distance—in fact, if this were not so, the great men would not be great, nor the ordinary men ordinary—there are also subsidiary qualities which help to constitute the great man's greatness, and which, nevertheless, the ordinary man may admire and imitate. And, taking this view of Mr. Darwin, how admirable was his devotion to the one great work of his life! He gave himself to the study of nature with all his heart and soul and strength; in a coarse, worldly sense, he had nothing to gain by it; nay, much of his work seems to have cost him not only labour but suffering, and his first great scientific journey is said to have entailed weakness of health through his whole life. Is there nothing to be learnt from such steady devotion and industry? And then, like other great men, he seems to have been conspicuous for modesty; fancying that other men could do as much as himself if they only tried, reminding one somewhat of Newton when he maintained that the chief difference between himself and other men was that he took more trouble to think about things than they. And then so calm, and apparently living in an atmosphere so much removed from the storms of passion and controversy: what a lesson there is here! No doubt it is more easy to be calm in the regions of natural science and observation, than in those of politics or theology or morals; but politicians and theologians may very well in their more exciting fields of controversy take example from the dignified

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composure with which such men as Darwin pursue their work. Moreover, the particular form which Mr. Darwin's studies assumed prevented him from enjoying the calm, retired peace which belongs to many branches of science: the views concerning evolution connected with his name have not unnaturally given rise to more excited feelings, and caused more terror and alarm, than perhaps any that were ever propagated; but I do not know that his temper was ever moved by this, and he never appeared before the public as one who felt aggrieved. I may add that though many attacks have been made upon religious truth in his name, he never made such himself; nay, I have every reason to believe that such attacks had not his sympathy, but were contrary to his most solemn convictions.[1]

[1] I extract the following from an article in the 'Lancet,' published soon after Mr. Darwin's death :—

'It is noteworthy that, following close upon the death of Darwin, comes the noble declaration of M. Pasteur in the oration custom compelled him to make as the successor of M. Littré, that faith in the infinite is not incompatible with, but actually grows out of, a precise knowledge of the facts of Nature, so far as her mysteries have been explored. M. Pasteur struck straight home to the heart of the secret cause of that scepticism which prevails among a certain school of scientists and philosophers when he said, "M. Littré's faith in positivism arose (in part, at least) from the mental quietude it offered on the great metaphysical questions. Negation as well as doubt incommoded him. Auguste Comte extricated him from both by a dogmatism which abolished all metaphysics." All really active minds must take refuge in dogmatism if they would find rest. Of the brothers Newman, one, after passing through a long series of phases of faith, suffered what has been alleged to be an eclipse of his faith. This energetic thinker actually took refuge in dogmatism of the type of, yet differing in many

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I cannot but think that a touching mark of greatness is to be found in the subject of his last scientific publication. Who has not read with wonder and delight the volume upon earth-worms? How many of us had realised, before we read that work, the marvellous agency of these humble creatures? Who would have thought that the crowning effort of one who had searched all nature, and had been bold enough to speculate concerning the descent of man, would be a laborious investigation of the habits, and the part in the general economy of nature, of the lowliest and nearly the least attractive amongst the creatures of God?

A brave, simple-hearted, truth-loving man: one whom I knew only by his writings and through common friends, and concerning whom, thus known, I have ventured to make the few remarks which I have now offered to you. I have said that I think,

important particulars from, that which Comte supplied to Littré. The other brother, being brought to the same strait in his intellectual life, sought rest in the dogmatism of the Roman Church and theology. We repeat, there is no rest without dogmatism—the dogmatism which abolishes the metaphysical, or the dogmatism which elaborates and embodies faith. M. Littré found rest, of a sort, in Comtism; Charles Darwin found rest in the faith of Nature's God. . . . No more wonderful and inexplicable fact has challenged the scrutiny of thoughtful minds during the last twenty years than the failure to realise that the postulate of evolution is creation—*Ex nihilo nihil fit;* or, if anyone regards that as a mere platitude, he cannot deny that to *evolve* any organism, however simple, from matter, which has not been previously organised, is impossible. The primæval germ of nature is a necessity of the hypothesis of evolution. Charles Darwin felt this to be the fact, and he was *not* an Atheist, a Materialist, or an Unbeliever.'

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like other great men, he has presented to us in his life and his works points of character and conduct which we may well admire and imitate, though we ourselves may have no title to greatness, and though also we do not accept as necessarily great and good everything which a great man may have said or done. But I cannot be content to leave the subject at the point at which we have now arrived: like the prophet of whom we heard in the First Lesson of this afternoon, I feel that I must speak the words which God bids me to speak, and that He has bidden me to speak not merely concerning natural science or the greatness of scientific men, but concerning Jesus Christ His only Son our Lord. I have picked up a few words from the Second Lesson, which seem to me to express in a pithy and pointed way exactly that which I should wish to say, in connection with the subject which has forced itself upon our minds this afternoon. Mr. Darwin has gone to his rest: his grave has received every honour that an Englishman's grave can receive: I, who have been invited to preach here this afternoon, have endeavoured to deal respectfully with his memory: but there will be, and must be for a long time to come, connected with his name, not merely the thought of a remarkable scientific epoch, but also the thought of an intense emphasis given to the question, What is the relation in which natural science stands to religious faith? This is no new question: it is one which is inherent

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in the very substance of thought and speculation: it is one of a number of questions which are always alive, but which sometimes seem to be in a condition of suspended animation, and then burst forth again into impetuous life, like a volcano which has been quiescent for a while. Of course it is impossible even to attempt to answer questions of this kind in a few sentences of a sermon; but I wish to suggest, or rather to remind you, not only that religious faith rests upon foundations which no physical discoveries can impair, but also that positive knowledge and religious belief are not antagonistic, but more properly supplemental, the one to the other. *I* believe—I am sure that *you* all believe—that such intellects as those which were given to Newton and to Darwin were given for the purpose of being applied to the examination of the universe, which God Who gave the intellect created and made. I cannot conceive the constitution of that man's mind, who does not feel uplifted and triumphant and joyous, when he realises the great steps which man has made in comprehending the secrets of this wonderful creation, of which he himself is the crown; but if I am told that because Newton discovered gravitation, therefore I can dispense with the Apostles' Creed, or that having got the works of Darwin I may burn my Bible, I reject the conclusion, not only as illogical and monstrous, but as contradicting a voice within me which has as much right to be heard as my logical understanding. I resist

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the conclusion, because I am certain that to accept it, or anything like it, would be to permit myself to be 'spoiled,' robbed, beggared, 'by philosophy and vain deceit,' according to the language of St. Paul, which we heard this afternoon. I am not only a being who can investigate the secrets of nature, and bend nature's forces to my purposes, and perform wonders of ingenuity; but I am a being who can suffer pain, can feel sorrow, can commit sin. I have a moral nature, which is as much and as truly a fact as is my intellect. I meet with experiences in this poor, sinful, anomalous world, which are just as true, just as necessary to be taken into consideration in forming a philosophy, just as important, or it may be ten thousand times more so, to the vast mass of mankind, as any truth which natural science can reveal; and God, as I believe, has recognised this side of my nature and my experience by taking human flesh and becoming man. 'The Word became flesh.' 'God so loved the world, that He sent His only begotten Son.' Do not try to deprive me of that blessed truth. They who hold it, who live upon it, who believe that they would be infinitely, hopelessly, pitiably poor without it, have no desire to speak lightly of other truths, but only they feel that they cannot give up this. 'Complete in *Him.*' Those few emphatic words of St. Paul seem to me exactly to meet the case: the knowledge of Christ supporting, supplementing, completing all other knowledge: ministering to wants which would

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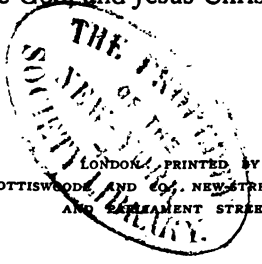
be otherwise overwhelming: binding up wounds which human knowledge cannot heal: giving rest to weary souls which have sought rest elsewhere, and have not been able to find it.

Oh! my Christian brethren, if the world-wide fame of such men as Newton and Darwin makes us wonder at the princely intellects with which they and other chiefs of the human race have been endowed—if by the tribute of a nation's homage at their open graves we bear our testimony to their greatness, and thank God for His mighty gift—if we feel that mankind in general, and our own dear land in particular, is enriched and glorified by the possession of such men—let us also be reminded by their return to dust that we need some knowledge which they cannot give us. No human light can illuminate the other side of the grave: the mystery of man's infinite being defies the treatment of all human *calculus*: the knowledge which man's soul requires is only 'complete in Him,' whom God has sent into the world in order that, knowing Him, we may know the Father.

'This is life eternal, that we might know Thee, the only true God, and Jesus Christ Whom Thou hast sent.'



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